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The Institute of Vitreous Enamellers

The Welsh Engineers' and Founders' Association

and

The Foundry Trades' Equipment and Supplies Association

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The Building Exhibition

This exhibition, which opened last Friday at Olympia, and will remain open until October 1, has a very special interest for various members of the foundry industry. Primarily, they are concerned in the direct supply of castings used in the construction of houses, and those utilised in the heating, ventilating and cooking services. A little further removed are those castings needed for the manufacture of builders' materials—bricks, glass and woodwork. Here, we think, it is desirable to interpose that never before has there been assembled under one roof in London such a representative collection of woodworking machinery, much of which is indistinguishable from that used in the pattern-shop. The third phase of outstanding interest is the concrete portrayal of the various materials offered as an alternative to cast iron. Happily from the foundry angle in some cases these have retained the traditional and perhaps not too satisfactory design of cast-iron goods. We refer particularly to rain-water castings, where the traditional designs have had insufficient thought bestowed upon them to line up with modern demands.

From an architectural point of view, the *ensemble* of the exhibition is higgledy-piggledy, as each standholder has chosen a style best suited to the display of his own goods. Some individual stands are excellent. We saw no new finishes in vitreous-enamelling, but a general extension of its use. In some cases the designs of fireplaces so treated were distinctly poor, being badly proportioned and finished in the dreariest of colours. They contrasted strangely with other firms' designs, which are so artistic as to cause a regret at the thought they would be quantity produced. A tendency was also noted to make cookers look like cabinets; in fact, the phrase "cooking-cabinets" is their commercial appellation. The electric cooker is gradually overcoming the inherent difficulty of rapidly boiling a kettle by devices guaranteed better to utilise the heat generated.

The outstanding exhibit is a rural slum cottage, inhabited only a few weeks ago, together with its modern counterpart. Delightful as some of these old places look from the exterior, the rural worker's wife has a genuine preference for a "council" house, because of the reduction of "donkey work" in its running. It seems that this agitation by the rural housewife is one which is bound to have serious and beneficial reactions on the foundry industry.

The light castings industry has reaped the advantage of contributing its not inconsiderable quota to the construction of the two million houses which have been built by loans from the Building Societies since the war. Much has been done by the country and municipal authorities, and there is at the moment a prospect of increased activity in the near future. Last month, the local "reporting" authorities passed building plans to the value of £6,302,100 as against £5,799,000 for August of last year, an increase of 8.7 per cent. Most of this rise was for housing plans, which at £3,965,200 were £354,300, or 9.8 per cent., higher. The tendency is particularly welcome, as the total plans for the first eight months of this year, at £67,729,000, were £6,751,000, or 9.1 per cent., lower than last. The Building Exhibition will make a really useful contribution to better trading conditions by showing to interested parties just what is nowadays available and future trends.

The Sir Robert Hadfield Laboratories

Elsewhere in this issue we give an illustrated account of the reconstructed laboratories of the Metallurgical Department of Sheffield University. These have been made possible through the magnificent generosity of Sir Robert Hadfield. For more than thirty years, Sir Robert has taken a great interest in this department, and has co-operated with its succession of professors by practical encouragement, and by placing the technical resources of his large works at their disposal.

The success of a faculty of a University can be assessed by the achievements of its past students and its contributions to the fundamental knowledge in the fields of activity which it serves. It would be invidious to catalogue the names of past students who have achieved international reputations, but it is no exaggeration to place it as high as one for each year of the existence of the department. So far as academic research is concerned, it should be sufficient to state that the vast majority of the microconstituents of the ferrous alloys were discovered and christened in the Department.

We are probably in touch with as many ex-students of the Department as anybody, and it is particularly pleasing to be assured that they are enthusiastic with the present conduct of the Department. Its obvious defects, both in tuition and equipment, have been eradicated, and the enlightened policy pursued by Professor Andrew has induced a feeling that once again the Sheffield University Metallurgical Department is the premier institution of its kind in the world.

Copper Still Climbing

BY "ONLOOKER."

The recently-published copper statistics disclosed a reduction of some 25,000 tons in the world stocks of refined metal, the biggest part of the fall occurring in the United States. At the same time there was a noteworthy increase in world production of blister. Perhaps the most cheering item was consumption, for there the U.S. figure was still on the upgrade at 43,000 tons, while extra-American absorptions amounted to about 117,000 tons. These figures are undoubtedly excellent, and it is not wonderful that the market in London has continued to show a very firm front, in spite of all the terrible uncertainties of the European situation.

One has to bear in mind, too, that early copper is none too plentiful, and the upshot of this is that in Whittington Avenue there is a spread of about £6 between standard and wire-bars. It seems likely that a fair amount of refined copper is being held by consumers either at their own plants or in warehouses, and recent events have brought a marked increase in the takings by governments who are determined not to be caught short of supplies if the worst should befall.

American Quotation Advanced

At the time of writing the U.S. domestic price has just been raised by 12½ points to 10¼ cents, delivered Valley, and although one may well ask why this was done in the face of a demand which is not particularly good, it seems probable that the persistent demands by Japan in America, coupled with the upward trend of values in London, have been responsible for this decision by the producers. Moreover, there is talk of the American quotation being raised still further. It looks very much as if once again the producers are doing everything in their power to get the value of copper up to the highest possible level. In this it would certainly seem that they are attempting to cut their own throats, for it should be obvious that if the value of any commodity is lifted too far, a falling off in consumption will occur.

At the present time this aspect of the matter is masked by the exceptional demand on account of armaments, but eventually this will pass and the copper people will find that in raising the price to a point which has allowed other and rival metals to compete successfully, they have made a very serious blunder. But for the present all seems to be well; output is being artificially controlled to a degree which makes it possible to stage a bull market both in New York and London, and the metal is having a good press on both sides of the Atlantic.

A recent feature of trading on the London Metal Exchange has been keen buying of the prompt position, as a result of which the contango has narrowed appreciably. Just what lies behind this demand it is hard to say, but not improbably bears have been busy covering in short positions which have been open for some long time past. Another possible explanation is that investors, having decided that at times of stress there is nothing so satisfactory as solids, are putting their funds into copper, which may certainly be regarded as a fairly safe lock-up. In any case, the net result is to put copper higher, and since nothing succeeds like success, one must suppose that this upward move is going to continue.

In due course production will undoubtedly respond to the spur of such an adequate return on the selling side, and stocks will mount rapidly as trade declines. This is the swing of the economic pendulum, which never fails to act as a corrective to the abnormal situations created by artificial schemes of price lifting. Grasping at the present opportunity may be all very well on some occasions, but in business it does not pay to be too greedy. Copper is now a low cost commodity with no justification for a high price.

Deoxidising Non-Ferrous Alloys

The question of the deoxidation of all melts of copper and its alloys arose from the original opinion that oxygen is the only undesirable constituent of the melt. This constituent consequently had to be absorbed as oxide and removed from the melt.

Modern metallurgical research has proved that the presence of oxygen in most of the copper-base melts is of minor importance, but that there are other factors, such as hydrogen, the injurious properties of which should not be underestimated. Mention, of course, should be made of such impurities that arise from aluminium oxides, and of the harmful slags that may be present in melts of aluminium-bronze or special brasses.

Phosphorus is the pre-eminently active element by means of which not only is solved the problem of accumulated oxides, but also that of hydrogen. The numerous Papers on the systematical work of Dr. W. Claus, of Berlin, and his collaborators deal with this problem. Regular and systematic treatment with phosphorus means, therefore, an improvement of the general properties of the castings obtained from such melts.

From the above it is clear why, in Germany, for instance, where phosphorus as an addition was introduced in 1875, deoxidation has become such a matter of routine, that pouring any copper-base alloy without applying a phosphor-deoxidant, with few exceptions, is hardly thought of. In America, and especially in Great Britain, this method is not so generally practised, and in many instances phosphorus alloys are only applied in the manufacture of phosphor-bronzes. Consequently, there are many foundries (and not only the smaller ones) that do not profit from the great advantages offered by systematic treatment with phosphorus, and this at the expense of the finished casting.

Such regular deoxidation of all copper-base melts, including tin-bronzes, red brasses, nickel, nickel-silver, etc., increases the flux effect and eliminates overheating and porosity. Apart from the reduction of all reducible oxides, the oxide impurities (slags), which are accumulated in the melt, are brought up to the surface and can be easily removed. The gas content of the melt is thus diminished, which, for all copper alloys, involves a reversal of the undesirable inverse segregation.

It is of outstanding importance for efficient treatment that the manner in which phosphorus is applied ensures an elimination of waste products and a prolonged reaction-period. It was with this object that Dr. W. Claus conceived the idea of using briquettes made of phosphorus and pulverised metallic constituents of the melt to be treated, in order to obtain a deoxidant which, along with a complete solubility, ensured a prolonged reaction and consequently a thorough effect upon the melt. Such briquettes can be manufactured in any metallic composition (zinc + phosphorus, zinc, lead + phosphorus, tin + phosphorus, etc.), according to the special requirements.

Such deoxidants compared with ordinary phosphor-copper or phosphor-tin, offer considerable advantages on account of their handiness, uniform shape and weight, thereby aiding correct weighing, and of their constant, high content of phosphorus.

MR. J. W. BRIGDEN, British Commissioner at Johannesburg, is at present in the United Kingdom on an official visit. Mr. Brigden will be at the Department of Overseas Trade in the week commencing Monday, October 3, for the purpose of interviewing manufacturers and merchants interested in the export of United Kingdom goods to the Union of South Africa, after which he will undertake a tour of some of the more important industrial centres in the provinces.

Random Shots

The Polish word for "mesh" goes something like this: "Wielkoso sita na ktorym zostraja." It is just this sort of thing which makes international affairs look so complicated! It reminds one of the story of the Chinese gentleman who was brought before the beak, and when called upon to speak he let loose a long monologue of incomprehensible words, all strung together and emitted in one long breath in that delightful sing-song voice such as only the Chinese are capable of producing. When he at last finished the Judge turned to the interpreter and asked what he meant. "He wishes to say, My Lord, that it was a *black* dog."

* * *

As to international situations being difficult, one must admit that the Czech problem is a teaser, but not insurmountable. Some people have a cheque problem every month, but manage to straighten it out somehow!

* * *

Even the bulls are becoming armament-minded; for, judging from an experience at one large Sheffield plant a few days ago, they have forsaken the traditional china shop and prefer instead to crash into the shops of steelworks.

* * *

A little boy, seeing a notice in a railway station which read somehow as follows, "Pedestrians are requested to use the other exit," asked his mother what all those big words meant. "It only means that walkers are asked to go out the other way. That, my son, is official language." "Official," said that youngster with tremendous scorn in his voice, "Artofficial, I call it."

* * *

The advent of another Building Exhibition at Olympia makes one realise a great change of outlook in the matter of property from that of Victorian days, for instance. In those days one used to think of what would happen when the 999 years' lease fell in. Nowadays one is chiefly concerned about what will happen when the house falls in!

* * *

Evidence of increasing unemployment in the light-castings industry is provided, so it seems, in the half-yearly report of the Ironfounding Workers' Association. In the old days when the great wool merchants found their business slacking off they immediately ordered the people to be buried in woollen garments. Some people would be only too glad to be buried in a couple of gutters or a fall pipe in preference to another ghastly alternative which seems to be looming into the foreground!

* * *

"Marksman's" pessimism this week may be due merely to a chill on the liver and the ill-effects of having been taken to a recital of tone-poems by one of those very modern composers who have so obviously taken their music lessons at the London School of Economics!

"MARKSMAN."

New Scottish Fireclay Mine

Considerable interest attaches to the recent opening of the Watstonhead fireclay mine at Morningside by the Morningside Fireclay Company, Limited, in the Millstone Grit formation. This formation has long been mined for high-class fireclay in the Glenboig and Bonnybridge districts, but has never hitherto been exploited for that purpose in the Morningside district. The firm formerly made firebricks from the clay pavement of the Lower Drumgray coal at Hyndshaw, but approaching exhaustion induced them to try out the Millstone Grit, and, after requisite boring, a mine has been driven into a 7-ft. bed of clay, equivalent in position and quality to the well-known Bonnybridge fireclay. At the same time the brickworks has been modernised by the installation of a 12-chamber Hoffman continuous kiln and a Fawcett "stiff plastic" brickmaker especially suitable for the manufacture of firebricks, of which it is capable of turning out 10,000 per shift.

The First International Foundry Congress in Poland

The 1938 International Foundry Congress was opened in Warsaw, the capital of Poland, on Thursday morning, September 8. The conference was organised by the Polish Association of Founders, who are to be congratulated upon their most successful organisation of the first international foundry congress to be held in their country. The congress was attended by about 350 persons, of whom about 150 came from other countries. The representatives of Great Britain and her overseas Dominions numbered twelve.

The meetings of the congress were held in the Polytechnic, a surprisingly large and magnificently equipped technical college with 4,000 students. The building provides at once a most palatial and a very convenient setting for a congress.

Opening Meeting

The opening meeting was held under the chairmanship of Mr. M. A. Roman, Minister of Industry and Commerce, who welcomed the congress in the name of the Polish Government. A presidential address was then delivered by Mr. C. Gierdziejewski, President of the Polish Foundrymen's Association, who opened his remarks by expressing the deepest homage and gratitude to the President of the Polish Republic, Prof. Ignacy Moscicki, who had extended his patronage to the congress. He then thanked the representatives of the Polish Government who had taken an active interest in the congress, mentioning by name the Prime Minister, who had kindly consented to take a place on the Honorary Committee; the Minister of Communications, Mr. J. Ulrych, who was present as representative of the Government; and the Minister of Industry and Commerce, Mr. M. A. Roman, who was presiding over the meeting. In welcoming the overseas delegates, Mr. Gierdziejewski said he was proud to greet representatives from Australia, Belgium, Czecho-Slovakia, Danzig, France, Germany, Great Britain, Holland, Hungary, Italy, Luxemburg, Rumania, South Africa, Switzerland and the United States of America. Their presence amply demonstrated the truly international character of the congress.

Continuing, the speaker emphasised the immense energy with which foundrymen were to-day developing foundry practice as a branch of technology, and not simply as a craft, and suggested that the question of special training for engineers in this profession ought to be fully examined in order to accelerate the development of the exceptionally important new ideas which were being submitted by the enlightened and enterprising representatives of this new science. The speaker referred particularly to the contributions of Prof. A. Portevin. The slogan of the present congress, "Collaboration between the Engineer and Foundryman and its Influence on the Efficiency of the Foundry," proved that foundrymen had come out of their shells and now invited the collaboration of their neighbours in the technical sphere.

In order to acquaint overseas visitors with conditions existing in the Polish foundry industry, Mr. Gierdziejewski quoted statistics compiled by the economics organisation of the Polish Union of Metallic Industries, known as the "Foundries Group," which gave the number of melting shops on January 1, 1938, as about 425 in about 340 foundry enterprises. There were 231 cast-iron foundries, among them being 12 malleable ones, 167 cast-iron machine foundries and 52 commercial cast-iron foundries, and there were 23 steel foundries. The production of iron castings in 1937 amounted to about 175,000 tons of a general value of 89,000,000 zloty. In conclusion, the speaker expressed the hope that the congress would contribute not only to the progress of foundry science but also that it would draw the attention of the Government to the problems of the Polish foundry industry and would thereby accelerate the proper recognition of its rôle and importance for national economy.

At the end of this address Mr. Paul Schwietzke (Düsseldorf), President of the International Committee of Foundry Technical Associations, spoke on behalf of the foreign visitors, and thanked the Polish Government for their interest and practical co-operation, and the Polish foundrymen for their welcome and their hospitality.

The general theme of the Papers was "Co-operation between the Engineer and the Foundryman." This subject was interpreted very broadly, and the thirty-five Papers covered almost every branch of modern foundry practice, as indicated by the list of titles at the end of this report.

There were four Papers by British authors, namely: "The Preparation and Milling of Sheet-Iron and Cast-Iron Enamels," by Mr. B. B. Kent, which was the official Exchange Paper of the Institute of British Foundrymen; "The Structure of the Foundry Industry in Great Britain," by Mr. V. C. Faulkner (Past-President of the Institute of British Foundrymen); "Nickel Cast Irons," by Dr. A. B. Everest, and "Magnesium Foundry Practice," by Mr. W. C. Devereux. In the absence of the authors, the first three Papers were presented by Mr. T. Makemson, and Mr. Devereux's Paper was presented by Mr. J. Pike.

At the conclusion of the opening meeting there was an unofficial luncheon at the Hotel Europesjke.

Dinner at the Golden Duck

The afternoon was occupied in visiting the Institute of Metallurgy and Metallography, a magnificently-equipped metallurgical research institution which is largely controlled by the Government, and which appears to correspond to the Metallurgical Department of our National Physical Laboratory. The day's programme was completed by an informal dinner at the restaurant "Zlota Kaczka," which, being interpreted, means the Golden Duck. During dinner a Polish orchestra played the national songs of the countries represented at the Congress, and like many similar orchestras was under the impression that the Britisher's favourite composition is "Tipperary."

Works Visits

Friday, September 9, opened with five hours of works visits, lasting from 8.30 a.m. to 1.30 p.m. During this period visits were paid to two important plants near Warsaw, namely those of Lilpop, Rau & Loewenstein, and the Government Metallurgical Works at Ursus. Short descriptions of these and other works which were visited will appear in a subsequent issue. Many of the delegates and ladies lunched together at the Restaurant "Bachus." A series of Papers was presented at the technical session in the afternoon, and again members and ladies met socially, this time for dinner at the Hotel "Bristol."

Saturday, September 10, opened with the presentation of Papers at duplicate sessions; lunch was taken at another restaurant, the "Pod Bukictem," and at 5.30 p.m. the whole party visited the Hotel de Ville, where they were received and entertained by the President (Lord Mayor) of the City of Warsaw. The thanks of the guests were tendered to the Lord Mayor by Mr. V. Delport.

Group photographed before a Wreath was Laid at the Tomb of the Unknown Warrior at Warsaw. Standing immediately behind the Wreath are (left to right) Mr. T. Makemson, Mr. P. Schwietzke and Mr. C. Gierdziejewski.

An instructive programme of visits was arranged for the ladies, and included trips to the Palace of the Kings of Poland, the residence of the President of the Republic, the Institute of Physical Education, and the famous Wedel chocolate factory. One of the most interesting places in Warsaw is the ancient wine shop, Fukier, which has existed for over 350 years. This wine shop was visited by the ladies officially, and by many of the gentlemen unofficially.

International Committee Meetings

Meetings of two important international committees were held on Sunday, September 11. The first was that of the International Committee on Testing Cast Irons, which was held under the chairmanship of the President, Mr. J. Léonard, of Liége. The Honorary President,

Prof. Portevin, of Paris, was also present. The British representative was Mr. T. Makemson, and Mr. Delport was present as the representative of U.S.A. Mr. Léonard announced his retirement from the position of active President, and it was unanimously resolved to invite Mr. J. E. Hurst, Past-President of the Institute of British Foundrymen, to become Mr. Léonard's successor.

The second committee meeting was that of the International Committee of Foundry Technical Associations, which was held under the chairmanship of its President, Mr. Paul Schwietzke, of Düsseldorf. Among the members of the Committee present were Mr. John Cameron, representing Great Britain, Mr. V. Delport, representing U.S.A., Prof. Gierdziejewski (Poland), Prof. Pisek (Czecho-Slovakia), Dr. Geilenkirchen (Germany), Dr. Vanzetti (Italy), Mr. J. Léonard (Belgium) and Mr. T. Makemson, hon. secretary of the Committee. Before commencing the formal business, the President paid a tribute to his predecessor, Mr. V. Delport, for his work as President in the year 1937, and proposed a vote of thanks to him, which was carried with applause. Among the items which were dealt with at the meeting were certain revisions and amendments of the Bye-Laws governing the detailed arrangements for International Foundry Congresses. Reports were received from the International Committee on Testing Cast Iron, the Sub-Committee on Foundry Defects and the International Dictionary Commission. A preliminary report was received on the International Congress to be held in Great Britain in 1939 and further congresses were approved as follow:—1940, Italy; 1941, Holland, and 1942, United States of America.

Dr. Guido Vanzetti, of Milan, was elected President for the year 1939, and France was invited to nominate the Vice-President for the same year. A considerable amount of routine business was transacted and the meeting concluded with votes of thanks to Prof. Gierdziejewski and the Polish Association for providing facilities for the meeting, to Mr. Makemson for his work as honorary secretary, and to Mr. Paul Schwietzke, the President.

Immediately after the meeting of the International Committee of Foundry Technical Associations, the whole of the members and ladies of the Congress assembled at the Tomb of the Unknown Soldier, where a wreath was deposited in the name of the Committee by the President, Mr. Schwietzke; the President of the Polish Association, Prof. Gierdziejewski; and the secretary of the Committee, Mr. Makemson. The members of the Committee were then entertained to lunch by the President and Frau Schwietzke. At this luncheon a tribute was paid to the *doyen* of the Committee, Mr. John Cameron, and to the work which he had done in promoting international co-operation among foundrymen by his interest and geniality.

British Party as Hosts

No official arrangements were made for the evening of Saturday, September 10, or the afternoon and evening of Sunday, September 11. During these periods the British party entertained some of their Polish friends in return for the wonderful reception and hospitality, both official and private, of which they had been the recipients since their arrival in Warsaw.

The Warsaw section of the programme terminated with the arrangements on Sunday, and at 7.0 a.m. on Monday morning the party commenced a tour of Poland, which continued for six days. An account of this most instructive and enjoyable trip will appear in a later issue. During this tour, the overwhelming hospitality and the guidance of the Polish foundrymen and their ladies added to the enjoyment and value of the tour.

The representatives of Great Britain and the British Dominions taking part in the Congress were:—Mr. J. Cameron (Past-President of the Institute of British Foundrymen) and Mrs. Cameron; Mr. F. W. G. Hobbs, of Benoni, South Africa, and Mrs. Hobbs; Mr. V. Delport; Mr. T. Makemson; Mr. and Mrs. J. Cameron, Jun.; Mr. D. A. H. Spring, of Sydney, Australia; Mr. E. Millington, Derby; Mr. J. Shaw, and Mr. J. Pike, of Slough.

It is unfortunate that this account has to conclude on a note of sadness. Mr. J. Cameron was unwell during the period spent in Warsaw but he bravely decided to commence the tour of the country. On arrival in Cracow at the end of the first day a doctor was called in and Mr. and Mrs. Cameron remained in Cracow while the rest of the party continued the tour. Mr. Cameron, Jun., and Mrs. Cameron were recalled to Cracow a day later, and when the remainder of the party returned to Cracow on Thursday, September 15, it was found that although Mr. Cameron was progressing favourably he would be unable to return home with the party. He has since been removed to a nursing home, and it is unlikely that he will be able to return to his home in Scotland before the early part of October. Mrs. Cameron and Mr. Cameron, Jun., have also remained in Cracow. At the closing banquet held in Cracow on Saturday, September 17, a letter of sympathy was sent to Mr. Cameron and was signed by representatives of ten nationalities.

LIST OF PAPERS

At the International Foundry Congress, held in Poland, the following Papers were presented:—

(1) Prof. Eng. G. Buzek and Dr. Eng. M. Czyzewski.—"Melting Losses in Cupola Practice as Affected by Coke Size" (Polish official Paper).

(2) Prof. A. Portevin.—"The Refining of the Structure of Castings" (French exchange Paper).

(3) Prof. F. Girardet.—"Application of Electrolysis to Micrometallography of Grey Iron."

(4) Eng. M. Olivo.—"New Cupola Melting Method Allowing the Adjustment of Carbon Content in Cast Iron."

(5) Dr. Eng. H. Resow.—"The Influence of Material, Shape and Moulding Practice on the Capacity of the Steel Foundry."

(6) Prof. Dr. Eng. R. Dawidowski.—"Advantages of Blast Pre-heating in the Cupola."

(7) Eng. J. Obrebski.—"Internal Weaknesses of Castings and their Causes."

(8) Eng. R. Suchanek.—"The Carburising of Steel in the Cupola as Affected by Coke Quality."

(9) Dr. Eng. M. Czyzewski.—"The Melting of Cast Iron Turnings in the Cupola."

(10) Dr. Eng. H. Jungbluth.—"Co-operation between Designer, Foundryman and Machine Shop" (German exchange Paper).

(11) G. K. Eggleston.—"Sand Control in Non-Ferrous Foundry Practice" (American exchange Paper).

(12) W. C. Devereux, F.R.Ae.S., M.I.Ae.E.—"Magnesium Foundry Practice."

(13) Eng. L. Olsansky.—"Iron and Steel Pipe Corrosion in Relation to Stray Currents" (Czecho-Slovakian exchange Paper).

(14) Dr. Ph. F. Roll.—"Limits of Definition and Defects in Micro Images."

(15) Dr. Eng. M. Smialowski and J. Jastrzebska.—"The Crystallisation of Iron and its Alloys."

(16) Prof. Eng. B. Holman.—"Compressive and Shearing Strengths of Moulding Sand."

(17) A. B. Everest, Ph.D.—"Nickel Cast Irons."

(18) Prof. Dr. Eng. G. Welter and Eng. J. Mikolajczyk.—"Soundness of Metals and Alloys under High Pressures in Relation to the Pouring Conditions."

(19) Prof. Dr. Eng. A. Krupkowski, Dr. Eng. M. Czyzewski and M. Olszewski.—"New Method of Determining Coke Reactivity by Means of Metallic Oxides" (Polish official Paper).

(20) Dr. Eng. M. Barigozzi.—"Investigation of the Inter-Relationship of Cupola Variables" (Italian exchange Paper).

(21) Dr. Eng. A. Nahoczky and Eng. B. Vécsey.—"Phenomenon Occurring in Cupola Melting Practice" (Hungarian exchange Paper).

(22) Prof. Dr. J. Czochralski and Eng. K. Migurska.—"Comparison of Various Methods of Purifying Aluminium Alloys."

(23) Eng. V. Samuel.—"The Ostrava Foundry Coke."

(24) Prof. H. Thyssen.—"Investigations of Chrome Cast Iron" (Belgian exchange Paper).

(25) B. B. Kent.—"Preparation and Milling of Sheet-Iron and Cast-Iron Enamels" (English exchange Paper).

(26) Eng. S. Pilarski and Eng. R. Szenderowski.—"Isothermal Treatment of Grey Cast Iron."

(27) Dr. R. Smoluchowski.—"Modern X-Ray Testing of Castings."

(28) Prof. Dr. Eng. G. Welter and Eng. Z. Bukowski.—"Influence of Repetitive Heat Treatment on the Mechanical Properties of Cast Aluminium Alloys RR-53 and Y."

(29) Prof. Dr. Eng. G. Welter and Eng. Z. Bukalski.—"Statical and Dynamical Investigation of Cast and Wrought Alloys Submitted to Simultaneous Tensile and Torsional Stresses."

(30) G. Gauthier. — "Improvement of Aluminium and Magnesium Alloys by Addition of Beryllium and Titanium."

(31) Eng. K. Gierdziejewski.—"Influence of Moisture Content of Moulding Sand on Strength Properties of Cast Aluminium Test Bars" (Polish official Paper).

(32) Dr. W. Claus.—"Co-operation Between Designer and Foundryman in the Production of Non-Ferrous Castings."

(33) Prof. Dr. Eng. I. Feszczenko-Czopiwski and Dr. L. Kozlowski.—"The Influence of Ti and Mo on the Magnetic Properties of Fe-Ni-Al Alloys."

(34) V. C. Faulkner.—"Some Notes on the Structure of the Foundry Industry of the United Kingdom."

(35) Eng. W. Gurycki.—"The Effect of Fluxes on Aluminium Bronze."

(36) Dr. Dornauf.—"On Aluminium Alloys."

Iron and Steel Production

The British Iron & Steel Federation reports that there were 81 furnaces in blast in Great Britain at the end of August compared with 90 furnaces at the end of July, eleven furnaces having ceased operations during the month, and two having resumed production. The production of pig iron in August, at 443,000 tons, included 106,000 tons of hematite, 233,600 tons of basic, 83,900 tons of foundry, and 11,100 tons of forge pig iron. Production in July was 507,800 tons. The production of steel ingots and castings in August was 658,900 tons against 683,200 tons in July. The majority of steel melting shops in England stopped for a week in August, and in some cases longer, in order to allow for operation of the holidays-with-pay agreement, and this has affected the figures. Compared with July, steel activity has maintained its ground.

Turkish Scrap Needs

The Turkish Government has extended the prohibition on the export of scrap iron and steel for a further period, and also has included all types of scrap metals, in order to cover to a fuller extent the raw materials requirements of the home metallurgical industries. Ships sunk in Turkish ports during the war are to be raised to provide scrap metal.

The Sir Robert Hadfield Metallurgical Laboratories at Sheffield University

The Department of Metallurgy at Sheffield University had its inception in 1884, being at that time associated with the Sheffield Technical School. The beginning was on a very modest scale, for then scientific metallurgy was in its infancy, and the courses of instruction were given under the direction of the Professor of Engineering, William H. Greenwood. The creation of such a department was, however, nothing less than a modern necessity, and there was an early appreciation of the commercial value of the educational courses.

A chair of metallurgy was created in 1889, and J. O. Arnold was appointed professor. A clever metallurgist, virile and enthusiastic, he furnished just that impetus which was required to start the Sheffield School upon its progressive course ranking it to-day amongst the most famous of the metallurgical-education centres of the world. The present professor is Dr. J. H. Andrew, who succeeded Dr. C. H. Desch when he was appointed to the National Physical Laboratory.

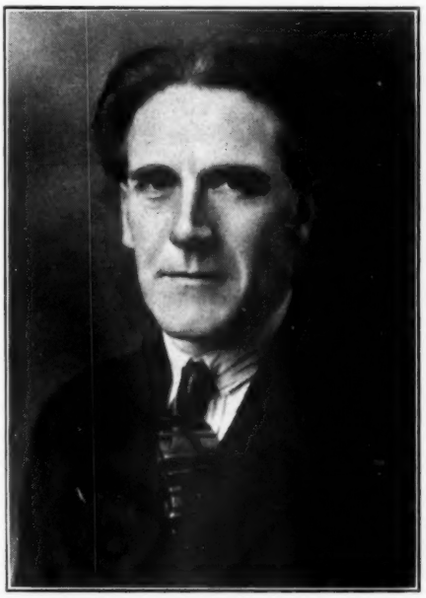
If the metallurgical laboratories of a university are to give of their best to industry, capital expenditure cannot cease with the initial equipment; new apparatus must be installed, and new systems evolved to meet the requirements of modern engineering and the systematic advances which are being made in metallurgical technique.

In this connection, the metallurgical department of Sheffield University is singularly fortunate in numbering amongst its friends Sir Robert A. Hadfield, Bt., D.Met., F.R.S., who has been a member of the Faculty of Metallurgy since its inception in 1917. It is not too much to say that his advice and exceedingly active interest has been largely responsible for the very high position the University now occupies in the realm of academic metallurgy. Sir Robert's interest has also been of a very practical nature. In 1917 he gave the sum of £2,000 for the creation of a special research laboratory. In 1934 he made a gift of £5,000 when the new foundry degree courses were inaugurated; indeed, he has never failed in a generous response to each and every call, and his contribution of £20,000 towards the new building scheme made possible the creation of the present metallurgical department, which in its entirety is second to none.

The naming of the new laboratories after Sir Robert is a fitting and graceful acknowledgment of moral and practical assistance so generously given, whilst the laboratories are not an unfitting memorial to one whose pioneer work in metallurgical research has placed him in the forefront of scientists of to-day. The laboratories were opened on September 14 by Sir William Bragg, O.M., K.B.E., D.Sc. (President of the Royal Society).

DR. J. O. ARNOLD

(First Professor of Metallurgy).



DR. J. H. ANDREW

(Present Professor of Metallurgy, Sheffield University).

Little remains of the original laboratories in which so many students received their practical training in analysis. Erected more than half-a-century ago, they had more than served their purpose, but were obviously wholly inadequate to meet the needs of to-day. The single-storey building which housed them has been demolished and an impressive two-storey structure erected in its stead. The older portions of the building at either end have been so reconstructed as to bring it into complete harmony with the new.

Accumulated experience combined with the most careful consideration of every detail has been responsible for an erection and lay-out, which, as will be seen from the plans, leave nothing to be desired. The equipment, with one exception, is also singularly complete; there appears to be nothing wanting. On the other hand, and perhaps this is equally unusual, there is nothing which could be regarded as unnecessary. The exception referred to is that of testing machines, the completeness of the apparatus in other respects rendering this missing link the more obvious. When our representative referred to what appeared to him a very important deficiency, he was informed that money was not available for their purchase. Surely that is a very minor consideration, which will be speedily remedied when the facts are known to industrial Sheffield. The cost of the necessary machines would probably not exceed £2,000, a trifling sum when one considers the value of the work of the Department, which is not alone of local, but also of national, interest.

Referring to Figs. 1 and 2 it will be seen that the upper storey of the building is approached by a passage, on the north side of which are a large panelled meeting room, the panelling of which was given by Mr. Joseph Ward (chairman of the Applied Science Committee) and a chemical balance room. On the south side are the private office of the professor, the secretary's office, records office and a staff laboratory.

The main analytical laboratory, which is situated at the end of the passage, is 103 ft. in length by 40 ft. wide and 18 ft. 6 in. in height, the walls being lined throughout with glazed bricks. The natural lighting is excellent and artificial lighting is adequate. Accommodation is provided for 227 students, the benches being divided into two aisles by a central arrangement of fume cupboards, 18 in number. This serves as the ventilating system for the whole laboratory, the air being drawn in through filters and exhausted to atmosphere through the main duct of the fume cupboards. At intervals are placed hot-air ovens and furnaces for the drying and burning of precipitates. There is also a special sulphuretted-hydrogen cupboard.

Immediately adjoining the analytical laboratory is a special room for carbon-combustion determinations and a central store. In the basement of the building are situated two lecture rooms, a staff room, a large metallography laboratory containing 18 students' microscopes of various designs, a special laboratory for physical determinations, such as thermal and dilatometry work, a specially-fitted dark room, a laboratory for polishing micro-specimens and for macro-printing, two research laboratories, and a large room set apart for mechanical testing, the equipment of which is, however, a matter for the future, together with cloak room, etc.

DR. C. H. DESCH

(Dr. Andrew's Predecessor in the Chair of Metallurgy).

The new building has been so welded into the older portion as to form as a whole a well-organised and well laid-out department. During the past six years important additions have been made to plant and apparatus in the older laboratories.

In the research laboratory which adjoins the new building is a large Hilger quartz spectro-

graph which was presented to the Department by Mr. Kenneth Gray, a new Finch electron camera, and a high-frequency melting furnace of small capacity, etc. Some five years ago the University purchased a Metropolitan-Vickers X-ray plant for use largely in connection with investigations of cold-working problems.

The cold-work research laboratory contains a cold mill with 10-in. rolls, which is driven by a motor of 125 h.p.; a wire-drawing bench and quite recently erected a 40-ton press for deep-stamping operations, which was presented by Mr. Percy W. Lee. The electro-deposition laboratory is in course of reconstruction and will be entirely re-equipped to enable practical instruction being given in modern methods of electro-plating.

The foundry, to which further reference will be made later, is unique for a university department, Sheffield being, in point of fact, the only British university which provides special degree courses in foundry science. The inauguration of these courses was due to the action of the Council of the Institute of British Foundrymen, whose appeal to the foundry industry resulted in the necessary funds being obtained to instigate the new procedure.

In the research department many special investigations are being carried out at the instigation of the Joint Research Committee of the Iron and Steel Institute and the British Iron and Steel Federation, and grateful acknowledgment is made of the financial grants in aid of the experimental work which is being carried out for the Ingot Committee, the Alloy Steel Research Committee and the Steel Castings Research Committee. In 1930 the Worshipful Company of Ironmongers founded a Fellowship and two scholarships for the purpose of encouraging research work on the cold-working of ferrous metals and in 1936 the Institution of Automobile Engineers provided funds for a special research on steel strip.

The investigations undertaken by the Department cover a wide field not only in metallurgy but also in the subject of refractories. It may be noted that at the present time there are, in addition to members of the staff, 22 research workers undertaking original investigations.

The Foundry

The foundry occupies a separate building, and is equipped for all founding operations such as the melting and casting of steel, cast iron and non-ferrous metals up to half a ton in weight. Obviously for instructional purposes the foundry includes the widest possible range of melting unit. The plant comprises a cupola of 2¼ tons per hr. melting capacity, by the Constructional Engineering Company, Limited, which is blown by a Keith Blackman fan. There is also a Morgan oil-fired lift-out crucible furnace of 90 lbs. for high-temperature work, and a Morgan bale-out oil-fired furnace for melting aluminium; also a gas-fired tilting furnace of 250 lbs. capacity. Air for these furnaces is supplied by two Keith Blackman fans which are installed on an elevated platform; the mid position beneath the platform is laid off as a metal stores.

In course of erection is a rotary furnace of ½ ton capacity which will be fired with pulverised fuel. Pulverised coal will be brought in and charged into the feed hopper, the capa-

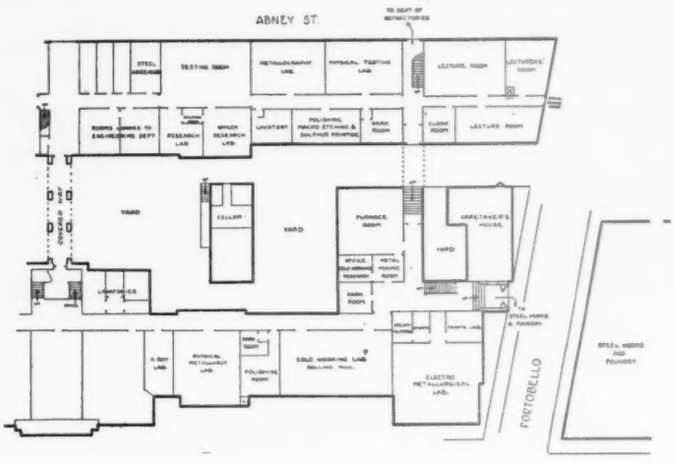


FIG. 1.—PLAN OF THE GROUND FLOOR.

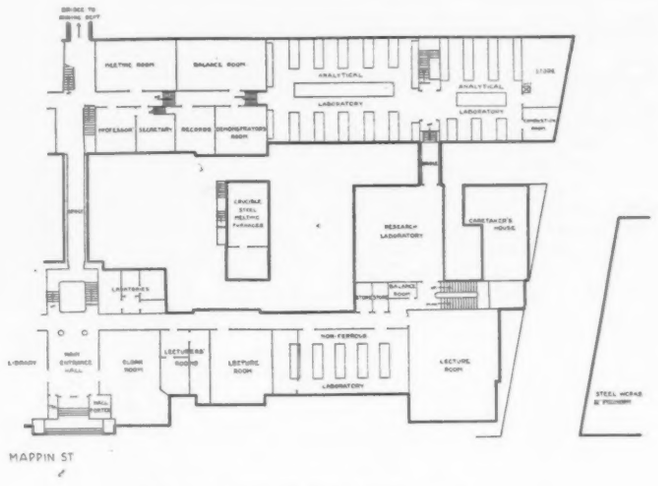


FIG. 2.—PLAN OF THE UPPER FLOOR.

LAY-OUT OF NEW METALLURGICAL LABORATORIES AT SHEFFIELD UNIVERSITY.

FIG. 3.—VIEW IN THE ANALYTICAL LABORATORY.

FIG. 4.—ANOTHER VIEW IN THE ANALYTICAL LABORATORY.

METALLURGICAL LABORATORIES AT SHEFFIELD UNIVERSITY.

city of which is from four to five melts. A flap valve is fitted into the waste-gas flue leading to the chimney, and when starting up, the waste gases will pass direct to the chimney. As soon, however, as the temperature of the gases in the flue reaches 300 deg. C. the valve will be turned over so as to divert the gases for preheating the secondary air.

The position of the present cupola was formerly the site of a Siemens furnace, which, however, was dismantled on account of the costly nature of its operation, coupled with the fact that, as then built, it did not lend itself to operation in accordance with the most modern practice.

Steel is now melted in a Greaves-Etchell electric furnace of 10 cwts. capacity. Adjacent to this furnace is an ingot-casting pit and a portion of the adjoining floor is laid off for steel castings, whilst the iron moulding and casting floor is in front of the cupola. The floor of this portion of the foundry is served by a 4-ton overhead crane. Mention may be made of a small gas-fired crucible furnace in which charges up to 10 ozs. of steel can be melted.

On the non-ferrous side of the foundry is a gas-fired furnace by British Furnaces, Limited; this is of the lift-out type and will take charges up to 50 lbs. Though mainly laid off for casting of non-ferrous metals, iron can be melted in this furnace if desired. There are two hand-ram moulding machines, one of which is fitted with mechanical drawing. There is also a mechanical riddle by the Constructional Engineering Company, Limited.

Sands are carried in a series of 12 steel-hopper compartments, which, to economise space, are ranged along the side of the platform previously referred to. The sand-preparation plant comprises an August sand mixer of 1¼ cwts.; adjacent is a core-blowing machine and the core stove, both of which are also of August's manufacture. There is also a sausage-core machine. Other equipment includes seven electric-welding points with all types of machines and seven oxy-acetylene welding benches.

Certain of the heat-treatment furnaces are also installed in the foundry. These include two gas-fired furnaces by British Furnaces, Limited, a gas-fired furnace by Richmond for the treatment of tool steels, and a special gas-fired furnace, which is electrically controlled. Normally this furnace is worked at 1,300 deg. C. and the control maintains this temperature within 2 deg.

In a separate shop there are two Birlec electric furnaces, one for temperatures up to 900 and the second for temperatures up to 1,400 deg. C. There is a third electric furnace which was designed and built by Mr. McDougall, a member of the staff. There is also a fully-equipped sand-testing laboratory.

The machine shops contain an assembly of up-to-date tools which, however, do not call for any special mention.

Figs. 3 to 8 illustrate various sections of the new laboratories.

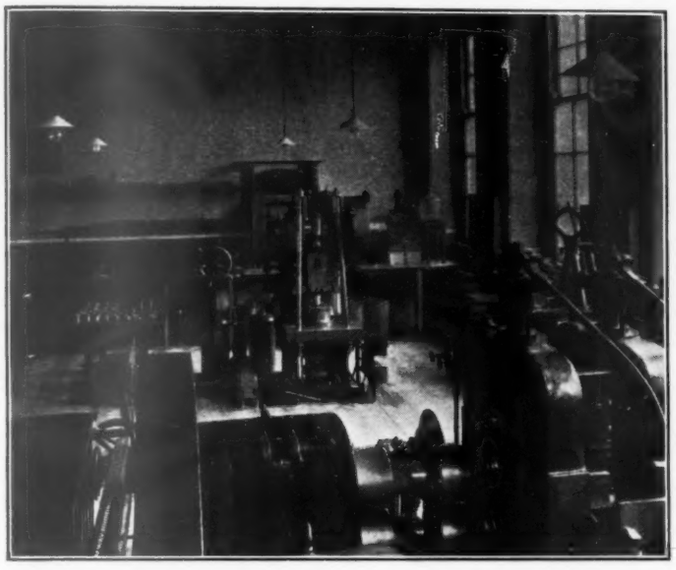


FIG. 5.—LABORATORY FOR COLD WORK.

FIG. 6.—VIEW IN THE RESEARCH LABORATORY.

FIG. 7.—VIEW IN THE FOUNDRY.

FIG. 8.—HEAT TREATMENT FURNACES AND SAND PLANT.

METALLURGICAL LABORATORIES AT SHEFFIELD UNIVERSITY.

Cast Iron Research and the Gas Industry

By J. G. PEARCE, M.Sc., M.I.Mech.E., F.Inst.P. (Director and Secretary, British Cast Iron Research Association)

(*Concluded from page* 201.)

Corrosion Resistance

Cast iron normally offers excellent resistance to corrosion compared with other ferrous materials not specifically manufactured to resist it. To dilute and strong acids and alkalis it offers resistance as good as, or better than, that of steel.

Soundness and uniformity of the casting are of great importance in resisting both corrosive and thermal attack. The variety of the influences exerted by each element prevents the influence of elements of composition being simply stated. Thus, in so far as silicon graphitises the metal and its increase is likely to produce coarser flakes, it is detrimental, but in so far as it goes into solid solution it aids in resisting corrosion, just as it aids in resisting heat, and indeed the most highly corrosion-resisting ferrous material is the 14 to 15 per cent. silicon iron so widely used in the chemical industry. Phosphorus does not materially affect resistance to acid corrosion, but lowers resistance to corrosion by alkalis.

Occasionally cast iron corrodes under circumstances which prevent the removal of oxidation products. The ferrite and pearlite are oxidised and the soft and friable oxide is held together by the interlacing strands of graphite, the shape being retained when other ferrous materials would have completely disintegrated. This phenomenon, erroneously labelled "graphititis" (graphitic decay or softening), is, however, not common.

Generally speaking, little can be done to improve the corrosion-resistance of machinable pearlitic grey irons by modifying the normal elements of composition, but low alloy additions do help considerably, in part by increasing soundness and homogeneity. Chromium present as carbide is detrimental, but nickel is advantageous and can be combined with chromium in proportions which permit the latter to go completely into solution.

The austenitic irons, Ni-Resist and Nicrosilal, already referred to, are, next to the high-silicon and high-chromium irons, the best available corrosion-resisting irons and are very soft, machinable, and take on a high finish. They have a corrosion-resistance comparable with that of phosphor-bronze, being 2 to 200 times as resistant as ordinary cast iron, according to the medium. The figures in Table VI give some idea of relative resistances. The resistance of high-chromium irons is referred to later.

TABLE VI.—*Comparison of Corrosion-Resistance of Austenitic and Ordinary Irons.*

	Relative loss in weight per unit area in unit time		
	$N.H_2SO_4$	N.HCl	$N.HNO_3$
1	2	3	4
Ordinary grey iron	328	301	218
Hematite	301	253	284
Ni-Resist	2.8	1.5	214
Nicrosilal	1.5	1.5	163

Corrosion at Elevated Temperatures

Corrosion at elevated temperatures involves both thermal and corrosive attack. Many surface treatments have been proposed, some being successful, in promoting resistance to heat and corrosion, but extended consideration would unduly prolong this Paper.

In practical operations, corrosion may take place through solid, liquid or gaseous media, oxidising or reducing, and irons containing chromium, silicon or aluminium are required to resist oxidising gases at elevated temperatures containing sulphur compounds. No ferrous material can indefinitely withstand reducing conditions at high temperatures in the presence of sulphur. At elevated temperatures the effect of combustion gases, hydrogen, gases containing hydrogen sulphide, and carbon dioxide, surpasses that of air or steam in the ascending order given, the effect of carbon dioxide being four or five times as severe as that of air.

Corrosion by Gaseous Hydrogen Sulphide

In a laboratory study of the resistance of ferrous materials to corrosion by gaseous hydrogen sulphide,[2] the nickel cast iron Ni-Resist had a resistance superior to all other materials tested (including plain and alloy steels, wrought and cast irons) except steels containing 12 to 27 per cent. chromium and steels containing 5 per cent. chromium, although the high-chromium cast irons which would correspond with the high-chromium steels were not tried. These would be expected to give high resistance. A somewhat similar ratio of resistance between ordinary cast iron and Ni-Resist has been recorded in smoke-scrubber and other tests where coal gas, sulphur and acid vapour combinations occur, in exposure to saturated hydrogen sulphide at 80 deg. C., and in resistance to various forms of chemical attack.

Action of Sulphur Dioxide

B. Waeser[3] says that sulphur dioxide will not attack retorts of cast iron or steel where it cannot dissolve in the condensed form, and that oxidising gases containing sulphur dioxide attack considerably iron and iron alloys at 400 to 600 deg. C. The layer of oxide and sulphate formed then protects the metal from further attack, so long as condensed acid water does not injure it. He quotes Rebald's (1931) figures showing the drop in the sulphur absorption by iron-chromium alloys as the chromium increases. He also quotes Dittrich (1933), who mixed hydrogen sulphide and hydrogen at various temperatures and pressures and found that high alloy chromium cast iron resisted corrosion up to about 375 deg. C., a higher temperature than any other material tried, including alloy steels. For mixtures of hydrogen sulphide along with both carbon monoxide and carbon dioxide, which may also contain hydrogen, high alloy chromium castings are relatively the most resistant. He concludes that reducing conditions should be avoided, but, if necessary, low carbon monoxide and carbon dioxide percentages should be aimed at and a high alloy chromium cast iron used for constructing the apparatus. These conclusions suggest the study of high chromium irons for use on gas-works plant.

Wear-Resistance

Cast iron has always been recognised as having high resistance to wear, as its universal use for cylinders, piston rings and liners testifies. There is no general relation between hardness, mechanical properties and wear or erosion, but in irons which are structurally similar an improvement in strength, hardness, uniformity or closeness will result in better resistance to wear. The harder the metal, the more important surface finish becomes. Alloy additions are helpful. Much work has been done on wear-resistance, but here again working conditions differ so much that prediction must be confirmed by a service test. Within ordinary limits, pressure and temperature do not appear greatly to affect wear. Phosphorus generally improves resistance to wear. Other things being equal, a pearlitic iron wears better than a ferritic or mixed ferrite-pearlite iron. For exceptional wear-resistance, especially where both wearing parts are metallic, nitriding or chromium plating may be used. By means of nitrogen hardening, Brinell figures up to 1,000 may be obtained.

White irons have advantages for wear-resistance in such services as coal preparation and for the crushing and preparation of coke, in which wear on ordinary ferrous materials is severe. An alloy iron of this kind, Ni-Hard, is the hardest and toughest cast iron available and has alloy additions comparable with those used in the wear- and abrasion-resisting steels. The principal additions are 4 to 5 per cent. nickel and 1.5 to 2 per cent. chromium, giving a martensitic iron with a Brinell hardness in excess of 600 in the sand-cast state, and able to scratch or cut glass. The carbon and silicon contents are respectively about 3.5 and 0.75 per cent. and the properties are as given in Table VII.

TABLE VII.—*Properties of Ordinary Cast Iron and of White Iron (Ni-Hard).*

	Ordinary cast iron.	Ni-Hard.
1	2	3
Brinell hardness—chilled ..	500	650 to 700
Tensile strength, tons per sq. in. —chilled	15 to 18	25 to 27
Tensile strength, tons per sq. in. —grey	8 to 11	13 to 16

The structure consists largely of martensite. Care should be used in applying white or martensitic irons where shock or impact has to be withstood.

GAS DISTRIBUTION

Centrifugal Castings

The use of cast-iron pipe for water mains preceded the rise of the gas industry, and such pipes, laid between two and three centuries ago, are still in service. Originally made horizontally, first inclined and then vertical casting superseded the original method. Over a century old in conception, the first practicable process for the centrifugal casting of pipe was evolved in 1914, and its major application, first in this country, began in 1921. The original Delavaud process provided for the production of pipes by the rotation of water-cooled metal moulds, following which an annealing process was essential. More recently, by the use of an insulating powder, coating the metal mould before pouring, it became possible to cast the pipe without annealing, but by a combination of the controlled use of the mould coating and a subsequent normalising treatment, it has been found possible to produce spun pipes with a much higher impact or shock strength than previously. In parallel with the later development of the metal mould process there was devised the process for making centrifugal pipes in sand moulds. To-day large and modern works, equipped in a way which has involved great capital expenditure, are engaged on the production of centrifugal pipes, and are able energetically to pursue any development of value.

Of the advantages of the centrifugally-cast pipe there is no doubt. Made on a continuous basis, it is controlled at every stage of manufacture with respect to raw materials and methods, and a very high degree of uniformity is achieved. The closeness and density of the metal permit a diminished thickness, with an even higher factor of safety, giving lower cost, increased fluid flow and easier transport. Pipes from 3 in. (sometimes from 2 in.) to 24 in. in diameter are supplied to the gas industry, which takes nearly half the output of one large works. Another firm has supplied 25,000 miles of spun pipe, about one-third being to the gas industry. It is probable that nearly half the output of cast-iron pipe in

this country is used for gas distribution. The centrifugal process has made practicable the use of cast iron for high-pressure mains (5 to 10 lbs. per sq. in.).

By adopting the 18 ft. length, joints are fewer and assembling is simplified. Considerable ingenuity has been expended on the provision of joints which combine the necessary tightness with a degree of flexibility for meeting modern traffic and laying conditions, a total variation of 8 or 10 deg. being possible between adjacent pipes. These joints are also made chiefly of cast iron, and it is interesting to note that high-duty iron is used for the bolts, so that all parts of the complete pipe offer the same resistance to corrosion.

Corrosion Resistance

On account of less corrosion troubles, many gas engineers prefer cast iron to other ferrous materials, because even with coated pipes perforation leads to decay in aggressive soils. In such soils a bitumen coating of $\frac{1}{4}$ in. appears to meet the case for cast-iron pipes.

The relative advantage enjoyed by cast iron in corrosion-resistance has been demonstrated during the past twenty years by the work of a Committee of the Institution of Civil Engineers in studying the deterioration of structures in sea water. This work is being extended, through the Corrosion Committee of the Iron and Steel Institute, to soil corrosion. For some fifteen years past the U.S. Bureau of Standards has made an elaborate series of studies of soil corrosion,[4] and again cast iron emerges very satisfactorily. The materials tested included steel, cast iron and malleable cast iron, wrought iron, many non-ferrous alloys and coated materials. The work is not yet complete, but it has gone far enough to show that cast iron corrodes to an extent only slightly in excess of far more expensive materials. In view of its relative cheapness, cast-iron pipe has a far better ratio of cost to life than any other ferrous material. In 1934 a Paper to the American Water Works Association[5] on the same data concluded that none of the rolled ferrous pipe materials showed outstanding superiority in all soils at the end of ten years, and that while the cast-iron specimens had rather more loss in weight and depth of pitting than rolled materials, this was not in proportion to the greater thickness of the cast-iron pipe. Finally, the corrosion of high-tensile cast iron, malleable cast iron and cast steel was not notably different from that of pit-cast pipe. The conclusions also referred to the protective coating investigation of the American Gas Association and the American Petroleum Institute. The conclusions are drawn that paint films and unreinforced soft coatings are of doubtful value in any soil; that the effectiveness of coating markedly increases up to 0.1 in. in thickness; asphalt emulsions are probably too soft to resist penetration by soil pressure; soil stresses are one of the most destructive agencies affecting coatings on the outside of buried pipes, and thick hard enamels or reinforced or shielded coatings appear to be required.

GAS UTILISATION

Light Castings

It is not necessary to go into the importance of cast iron in consumers' appliances beyond recognising that every gas engineer is interested in the development of simple, attractive, convenient, safe and economical means whereby gas may be made to serve the purposes of domestic life Anyone visiting a modern trade exhibition is astonished at the variety of such appliances—stoves, cookers, boilers, fires, heaters, radiators, water heaters, washing machines, refrigerators, irons. Their manufacture is the concern of the light castings sections of the foundry industry, now widely spread throughout the country, but having its historic origin in Falkirk, where the British Cast Iron Research Association has a branch laboratory. During the last few years considerable rationalisation has taken place in the industry, and a number of firms are now linked in a few small groups. The specialisation thereby permitted has facilitated broader policies with respect to publicity and advertising, research and development, which will be increasingly reflected in the quality of the product.

Broadly similar to that of the other branches of the industry, the technique of light castings production involves such delicacy of touch that the operative develops special manipulative skill peculiar to his branch of work. The use of phosphoric irons enables the molten metal to take sharp impressions of the mould. The manufacture of light castings calls for the provision of very hot metal of closely controlled composition to yield grey and machinable iron in the very thin sections involved. It calls upon all the resources of the metallurgist and foundry manager in sand control and in melting and moulding practice, especially in overcoming the natural shrinkage of the metal during cooling. In two directions notable advances have been made; firstly, in the planning of methods of continuous production and the development of the necessary plant for moulding, sand conveying, sand treatment, and so on; secondly, in the application of improved finishes.

Enamelling

Shot-blasting the finished casting has become a universal preliminary to the application of some form of vitreous enamel, now available in a wide variety of colours of great charm. The ceramic base is applied either in fluid or powder form to the carefully cleaned casting, which is then fired to give a hard, vitreous coat which can be readily cleaned. A large number of light castings foundries are equipped to finish their castings in this way, and some of the most difficult technical problems the industry provides arise in this work. The development has been rapid, but research is being carried out to permit close control both of the enamel and of the process. Furthermore, enamels are now being used which are much more resistant to the fruit and other acids with which they may become contaminated, and these acid-resisting enamels, more difficult than ordinary enamels to apply, are in more general use in this country than elsewhere.

Apparatus for Industrial and Public Uses

Of apparatus involving the use of gas for industrial and public works purposes, it need only be said that the problems provided are broadly similar to those arising with respect to gas works plant itself and have been covered earlier.

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Dutch Steelworks Proposal

It is reported from the Netherlands that an American syndicate proposes to erect a large steelworks in Holland for making concrete bars, rails, and harbour and dam structurals. No information is forthcoming as to the proposed location of the works or the groups interested in the scheme. The Ijmuiden steelworks is stated not to be concerned in the project and is starting up its own steel plant early next year.

A.R.P. and Rating Assessments

Rating and Taxation Acts are seldom of much beneficial interest to the average firm or individual, as they are usually in the direction of new imposts. Therefore the Rating and Valuation (Air Raid Works) Act, 1938, and certain provisions of the Finance Act, 1938, may be noted as being in the other direction.

Local Authority: Rating and Valuation

The Rating and Valuation (Air Raid Works) Act, 1938, provides that valuations for rating purposes shall not include any rating value for any room or any other part of the hereditament which has been added (or was included in the hereditament before it was first assessed) if used solely for air raid protection purposes; furthermore, no value is to be assessed to any structural alteration or improvement made for the same purposes. If such premises are used for purposes other than for air raid precautions, they will be assessed for rating, and this 1938 Act gives power to rating authorities under the Acts governing inner London (1869 to 1930 Acts) to schedule a provisional list for this purpose; ordinarily under the inner London Acts an assessment once made, except in certain circumstances, can only be altered at each quinquennial valuation. This 1938 Act will apply to the Rating and Valuation (Metropolis) Acts, 1869 to 1930, which apply to inner London (L.C.C. area), and the Rating and Valuation Acts, 1925 to 1938, which apply to outer London and elsewhere in England and Wales. The Rating and Valuation (Air Raid Works) (Scotland) Act, 1938, gives similar exemption to that explained above, as regards rating assessments in Scotland.

Income Tax—Schedule A Assessments

By the Finance Act, 1938, it is similarly laid down that no assessment (under Schedule A) is to be made in respect of any room or any part of a hereditament or in respect of any structural alterations or improvements made *solely* for air raid protection purposes, and this will apply to existing properties and to any hereditament which may be built at any time. In the cases of rented or leased properties, however, if an increased rent is charged by virtue of these buildings, parts, additions, etc., then this exempting from tax provision will not apply, and the ordinary assessment procedure will follow.

Similarly as with the Rating Act, if any part is used for any other purpose, the part becomes liable to being assessed for tax.

Special Points

Under Schedule D (Income Tax on Profits), a firm can deduct the annual value (being gross value less repairs allowances ordinarily) as a trade expense, and if the annual value is in respect of a hereditament such as a factory or similar establishment (roughly, premises where machinery is used), an additional deduction is allowed equal to the repairs allowance under Schedule A or one-fifth of the local authority rateable value (one-sixth London and Scotland), the operative amount being whichever is the lower figure. By the Finance Act Air Works provisions under review, the amount of this deduction for repairs, for Schedule D purposes, is to be reckoned out on an assessment which is to include a value assessed for the air raid parts, etc., even though that part, etc., has been exempted from Schedule A tax payments by the provisions under review.

These rating and taxation exemption provisions will apply, of course, to private residences as to business premises, and separate buildings will be exempt from rates and income tax the same as if part of a building—for example, air raid shelters erected independently of the main building or house.

Magnesium Foundry Practice*

By W. C. DEVEREUX, F.R.Ae.S., M.I.Ae.E.

The main advantages arising from the use of magnesium alloys result from low specific gravity which is only about 1.8 as compared with 2.8 for aluminium and about 7.2 for steel. Although frequently classed together as light alloys, magnesium and aluminium differ in certain essential features from the standpoint of the foundry, the chief difference resulting from the extreme combustibility of the molten magnesium and the rapidity with which it will react with moist sand.

Melting Practice

The development of a technique for the satisfactory melting and casting of magnesium is therefore centred around these peculiarities although as in the case of aluminium the lightness

TABLE I.

B.S. mesh.	Silica sand.	Mansfield sand.	Southampton sand.
	Per cent.	Per cent.	Per cent.
18	Nil	Nil	Nil
44	12	2.5	Nil
52	27.5	1.5	3
85	41.5	7.0	20
100	2.25	7.0	8
120	1.75	18.5	16
150	1.25	17.0	18.5
200	0.75	28.5	21.5
Passing 200	0.5	13.5	12.0

of the alloy combined with a tendency to form unsound castings has to be taken into account.

Magnesium is usually melted in steel crucibles in oil-fired furnaces although coke furnaces are sometimes preferred. The steel used for the crucible has been the subject of some considerable investigation since it is found that mild steel does not withstand the action of the fluxes and deteriorates rapidly. In choosing a heat-resisting steel it is important that the steel should have a low nickel content on account of the marked tendency for magnesium to absorb nickel from the crucible. Chromium and cobalt are not easily absorbed. It is possible with extreme care to melt magnesium in a crucible with a closely fitting lid without the use of a flux, depending merely on an atmosphere of sulphur vapour for protection against oxidation. The method is, however, unsatisfactory since it results in dross inclusions and blowholes in the casting and superior results have been produced by the use of fluxes.

In order to produce satisfactory castings free from dross and flux the choice of flux and the method of procedure call for the exercise of considerable discretion, and in this respect it should be noted that the German, British, and American practices, although fundamentally similar, differ in some important details. In the German practice two fluxes are used (British Patent No. 219,287) one having a relatively high and the other a low melting point. The procedure adopted is as follows:—

During melting a sufficient quantity of the low melting point flux is introduced to prevent oxidation and when the metal is completely molten a further quantity is added and the whole stirred in order to remove oxide inclusions from the liquid metal. The flux is then cleaned off and a quantity of the high melting point flux added, the metal heated to a temperature of 800 to 850 deg. C., and then cooled to the casting temperature which is approximately 700 to 720 deg. C., the object of the pre-heating before melting being to refine the grain size of the final casting.

In the British practice one flux only is used (British Patent No. 427,316), this flux having the property of fusing readily when added to the molten metal and then caking to form a hard crust which is easily removed prior to pouring.

Green Sand Castings

When molten magnesium comes into contact with moist sand it will react immediately and vigorously and for this reason in the early days of its development, sand casting of magnesium was extremely difficult and had to be carried out in baked moulds. At the present time, however, it is possible to make satisfactory castings in green sand by the use of inhibitors which are materials added to the sand to prevent burning of the magnesium. In the German practice, sulphur (5 to 10 per cent.) and boric acid are added to the sand and this mixture is extremely effective. In the British practice ammonium-bifluoride is used and when the molten magnesium comes into contact with sand containing this fluoride a coating of insoluble magnesium fluoride is formed on the metal and this has the effect of preventing burning and corrosion. A considerable amount of work has been carried out by various investigators to discover other more efficient inhibitors and although such materials as ammonium boro-fluoride, naphthalene, resinous oils and volatile hydro-carbons and certain alkaline sulphites have been found effective they have not yet reached the commercial stage.

Sand Preparation

For the manufacture of sand castings in any metal or alloy the selection of a suitable moulding sand is a matter of considerable importance. In the case of magnesium alloys it is essential that the correct type of moulding sand be chosen. Many foundries casting the heavier metals and even some foundries casting aluminium alloys use natural moulding sands. These natural sands are sand mined or quarried from a particular sand pit and are of such composition that they contain a percentage of clay or other bonding agent. These sands are prepared for foundry use by milling and mixing with a certain per-

TABLE II.—*Compression Strength of Bentonite-Bonded Sands.*

Synthetic sand.	Soft ramming. Lb. per sq. in.	Medium ramming. Lb. per sq. in.	Hard ramming. Lb. per sq. in.
96 per cent. silica sand 4 ,, Bentonite	1.4	3.1	3.1
94 ,, silica sand 6 ,, Bentonite	1.6	2.2	3.3
92 ,, silica sand 8 ,, Bentonite	2.2	4.0	5.1

centage of used floor sand. Often little consideration is given to the physical characteristics of such sands and provided castings produced from them have a smooth finish and are free from scabbing and surface blowholes the foundries are satisfied with these sands as moulding materials.

In the case of magnesium, several factors have to be taken into consideration which are not of such great importance in the founding of heavier metals.

The first of these to be considered is density. Molten magnesium at a temperature of 700 deg. C. has a density of only 1.54. Owing to this it is of primary importance that any gases contained in the mould, such as air, water vapour or hydrogen, formed by the reaction of the molten magnesium with water vapour, have free exit from the mould, and such exit cannot be provided by the use of risers and vents alone. It is therefore essential that the sand used has a high permeability value in order that the mould gases can readily escape through many passages between the grains of sand. With natural moulding sands this permeability value is generally low. If such sands were used for magnesium casting, especially in the green state, the resultant castings would contain many surface blow-holes which would be revealed on machining. In order to avoid this difficulty, synthetic moulding sands are used. By the use of such a sand it is possible to control the most important factors, such as permeability and moisture content, by frequent checking with suitable apparatus. Such synthetic sands are obtained by mixing a selected grade of dry silica sand and adding thereto a specific quantity of

TABLE III.—*Influence of Iron Oxide on Green Bond Strength.*

Synthetic sand.	Soft ramming.	Medium ramming.	Hard ramming.
96 per cent. silica .. 2 ,, Bentonite .. 2 ,, oxide ..	1.0	1.4	1.8
95 ,, silica .. 2 ,, Bentonite .. 3 ,, oxide ..	1.1	1.9	2.1
94 ,, silica .. 4 ,, Bentonite .. 2 ,, oxide ..	1.9	3.1	4.0
92 ,, silica .. 4 ,, Bentonite .. 4 ,, oxide ..	1.2	3.3	4.6
92 ,, silica .. 6 ,, Bentonite .. 2 ,, oxide ..	2.9	4.7	6.5

suitable binder. A suitable silica sand would have the sieve analysis as measured with a set of British Standard test sieves, as is set out in Table I.

It will be observed from this that approximately 93 per cent. of the silica sand is coarser than 100 B.S. mesh, and that 81 per cent. is between 44 and 100 B.S. mesh. For the sake of comparison, a similar sieve analysis of two natural moulding sands are also given after the samples have been dried. These samples are from the Mansfield and Southampton pits respectively.

It will be noticed that with the two latter sands only 18 per cent. is coarser than 100 B.S. mesh in the case of the Mansfield sand and 31 per cent. in the Southampton sand; also that 77.5 per cent. of the Mansfield and 68 per cent. of the Southampton sand is finer than 100 B.S. mesh.

Sand Preparation and Control

For preparation for magnesium foundry purposes the silica sand would be mixed with a colloidal clay binder. A type of clay known as Bentonite has been found to be suitable, the amount necessary to obtain a suitable bond being approximately 4 per cent. This mixture is moistened with 4.5 per cent. of water whilst being milled in a suitable sand mill.

The permeability of the sand may be measured using an apparatus by means of which a known volume of air under constant pressure is passed through a cylinder of sand of fixed dimension and rammed to a known degree. The time taken for the passage of the air is used as a permeability factor and is measured in cubic centimetres per minute.

The permeability value of the synthetic sand described would be between 140 and 170 c.cs. per minute, and that on the Mansfield 21.5 c.cs. per minute; it will be observed that these latter sands contain a large percentage of grains below 100 mesh and have a very low permeability value and owing to this are generally unsuitable for magnesium founding.

It is also interesting to note that although the Southampton sand has not so many fines as the

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Mansfield sand, its permeability value in the green state is lower than that of the Mansfield. This is due mainly to the percentage of water it will contain without becoming too wet for moulding purposes.

It has been found that Mansfield sand in a suitable condition for moulding contains approximately 6 to 7 per cent. moisture while Southampton sand will hold 10 to 11 per cent. of moisture. Synthetic moulding sand with 4 per cent. of clay binder contains only 4 to 5 per cent. of water and this amount is rigidly controlled as any excess of water in a green-sand mould for magnesium casting would lead to disastrous results.

TABLE IV.—*Mechanical Properties (As Cast Condition).*

	10 per cent. Al. 0.2 per cent. Mn. Rmdr. Mg.	8 per cent. Al. 1 per cent. Zn. 0.3 per cent. Mn. Rmdr. Mg.	6 per cent. Al. 3 per cent. Zn. 0.3 per cent. Mn. Rmdr. Mg.
Proof stress 0.1 per cent., tons per sq. in.	4.5 to 5.5	4.5 to 5.5	4.5 to 5.5
Ultimate stress, tons per sq. in.	8 to 10	9 to 11	9 to 11
Elongation on 2 in., per cent.	1 to 3	3 to 5	5 to 5
Compression strength (ultimate), tons per sq. in.	22 to 24	22 to 24	23 to 25
Compression proof stress, 0.1 per cent., tons per sq. in.	6.5 to 7.5	5.5 to 6.5	6 to 7
Fatigue range (20 million reversals) (plain bars), tons per sq. in.	± 5.7	± 5.0	± 5.0
Brinell hardness (500 kg., 10-mm. ball, 30 secs.)	55 to 65	50 to 60	50 to 60
Specific gravity	1.81	1.81 to 1.83	1.83
Thermal conductivity (C.G.S. units at 18 deg. C.)	0.32	0.32	0.32
Coefficient of thermal expansion (cms. per deg. C.) (average):			
20–100 deg.	23.9×10^{-6}	25.6×10^{-6}	25.6×10^{-6}
20–150 deg.	25.0×10^{-6}	26.3×10^{-6}	26.3×10^{-6}
20–200 deg.	26.0×10^{-6}	27.1×10^{-6}	27.1×10^{-6}

Experiments have been made to determine the optimum amount of clay binder necessary to obtain a suitable green bond strength. Test samples have been rammed in a standard rammer of the same type as that used for preparing the sample for permeability determinations.

The samples in cylindrical form were placed on the pan of a B.C.I.R.A. compression testing apparatus, and pressure applied by means of a screw thread. The load in pounds was noted when the specimen crushed and this value converted into pounds per sq. in. Table II gives comparative values for various percentages of clay binder. These values are for the equivalent of soft, medium and hard ramming. In each case the percentage of moisture is constant at 4 per cent.

For comparison results of similar tests given by Mansfield sand were: Soft ramming, 1.6; medium ramming, 2.8, and hard ramming, 4.5 lbs. per sq. in. In general, a synthetic moulding sand containing between 4 and 6 per cent. of clay binder constitutes a suitable moulding material for magnesium founding, and it is found that with percentages above 6 per cent. the sand tends to become sticky. This sand, however, suffers from one marked disadvantage, in that it cannot be skin dried, as the face of the mould readily becomes friable, also during hot and dry weather the sand rapidly air dries and is somewhat difficult to handle. Some experiments have been carried out with the addition of hydrated iron oxide to the silica clay mixture. The addition of this compound has the effect of markedly increasing the green bond strength and at the same time of allowing the mould to be skin or completely dried without crumbling, and rendering it less susceptible to the air drying effect. Some values for bond strength with the addition to the synthetic sand are given in Table III.

It has been found that some of the latter mixtures are too strong for ordinary moulding purposes and a mixture with 94 per cent. silica sand, 4 per cent. Bentonite and 2 per cent. hydrated iron oxide is the most satisfactory. While it cannot be stated that these mixtures fulfil the ultimate requirements of a moulding sand for magnesium alloys there appears to be a definite advantage from the addition of hydrated iron oxide to a mixture of silica sand with colloidal clay.

TABLE V.—*Mechanical Properties (Solution Treated).*

	10 per cent. Al. 0.2 per cent. Mn. Rmdr. Mg.	8 per cent. Al. 1 per cent. Zn. 0.3 per cent. Mn. Rmdr. Mg.	6 per cent. Al. 3 per cent. Zn. 0.3 per cent. Mn. Rmdr. Mg.
Proof stress, 0.1 per cent., tons per sq. in.	5 to 6	4.5 to 5.5	4.5 to 5.5
Ultimate stress, tons per sq. in.	14 to 16	14 to 16	14 to 16
Elongation on 2 in., per cent.	7 to 9	9 to 14	8 to 10
Compression strength (ultimate), tons per sq. in.	23 to 25	24 to 26	21 to 23
Compression proof stress, 0.1 per cent., tons per sq. in.	5.5 to 6.5	4.5 to 5.5	4.5 to 5.0
Fatigue range (20 million reversals) (plain bars), tons per sq. in.	± 6.0	± 5.0	± 5.0
Brinell hardness (500 kg., 10-mm. ball, 30 secs.)	55 to 65	50 to 60	45 to 55
Specific gravity	1.81	1.81 to 1.83	1.83
Thermal conductivity (C.G.S. units at 18 deg. C.)	0.31	0.30	0.32
Coefficient of the thermal expansion (cms. per deg. C.) (average):			
20–100 deg.	23.9×10^{-6}	25.6×10^{-6}	25.6×10^{-6}
20–150 deg.	25.0×10^{-6}	26.3×10^{-6}	26.3×10^{-6}
20–200 deg.	26.0×10^{-6}	27.1×10^{-6}	27.1×10^{-6}

Mechanical Properties

Compared with aluminium alloys it may be said that cast magnesium alloys possess a lower proof and relatively high fatigue strength. The low proof stress is coupled with moderately good resistance to shock and the alloys are therefore quite suitable for components which are not subjected to continuous high stresses, and are eminently suitable for structural parts subjected to temporary loads of a high order. In view of the good fatigue properties of the alloys it would be expected that they would be suitable for the construction of components subjected to high fatigue stresses, but, as previously pointed out, they are prone to shrinkage porosity which is generally located at changes in section. This defect, inherent in magnesium castings, would be best overcome by close co-operation between the foundryman and the designer to produce a casting free from those pecularities which tend to cause porosity at the most highly stressed parts.

The mechanical properties in the cast condition of the three alloys most widely used are given in Table IV.

Each of the alloys detailed in Table IV is amenable to heat-treatment and may be used either in the solution treated condition or after double treatment (solution treatment followed by precipitation hardening). The properties of these alloys in the heat-treated condition are given in Table V.

Some of these alloys may also be hardened by precipitation, as shown in Table VI.

The heat-treatment of magnesium, which in the case of the binary alloys with aluminium consists of maintaining the alloy at 420 to 425 deg. C. for a period of 15 to 25 hrs., gives rise to some difficulty owing to the fact that there is a tendency for the alloys to catch fire particularly in an atmosphere of stirred air. Three methods are in use to overcome this difficulty. The German method consists of carrying out the heat-treatment in a bath of mixed dichromates (British Patent No. 448,994) or in an electric furnace in which there is an atmosphere containing sulphur dioxide. In the American practice the heat-treatment may be carried out in a vacuum furnace, and it is claimed that this method is completely satisfactory.

TABLE VI.—*Mechanical Properties (Solution and Precipitation Treatment).*

	10 per cent. Al. 0.2 per cent. Mn. Rdmr. Mg.
Proof stress, 0.1 per cent., tons per sq. in.	7.0 to 9.0
Ultimate stress, tons per sq. in.	15.0 to 17.0
Elongation on 2 in., per cent.	1 to 3
Compression strength (ultimate), tons per sq. in.	27 to 29
Compression proof stress, 0.1 per cent. tons per sq. in.	9.5 to 10.5
Fatigue range (20 million reversals) (plain bars), tons per sq. in.	± 5.0
Brinell hardness (500 kg., 10-mm. ball, 30 secs.)	75 to 85
Specific gravity	1.81
Thermal conductivity (C.G.S. units at 18 deg. C.)	0.32
Coefficient of the thermal expansion (cms. per deg. C.) (average):	
20–100 deg.	23.9×10^{-6}
20–150 deg.	25.0×10^{-6}
20–200 deg.	26.0×10^{-6}

Catalogue Received

Dry Vacuum Pumps. Pamphlet No. 256 just received from Reavell & Company, Limited, Ranelagh Works, Ipswich, gives particulars of a wide range—actually seven sizes—of horizontal double-acting dry vacuum pumps. It is interesting to note that the valves are of the parted plate type and made from stainless steel. The lubrication for the larger pumps is mechanical and is of the multiple-feed type driven by belt from the crankshaft so as to provide a predetermined feed of oil to all the working parts. The maximum vacuum obtainable with a 30-in. barometer varies from 29.4 in. with the small sizes to 29.6 in. with the large sizes. The smallest model has a 9½-in. dia. cylinder with an 8-in. stroke and the largest a 26-in. dia. cylinder with a 22-in. stroke.

Firth-Vickers Rust, Acid and Heat-Resisting Steels

Firth-Vickers Stainless Steels, Limited, Staybrite Works, Sheffield, have issued a revised edition of their comprehensive publication of 180 pages entitled "Firth-Vickers Rust, Acid and Heat-resisting Steels." This well-illustrated publication covers every aspect of the manufacture, properties, manipulation and applications of Firth-Vickers special steels. In addition to this very useful reference book the firm has also issued two interesting booklets entitled: "The Manipulation of Corrosion- and Heat-resisting Steels," and "The Machining of Corrosion- and Heat-resisting Steels," the former covering forging, drop stamping, cold, hot and deep pressing, soldering and brazing, and welding, and the latter deals with details of typical tools, rough turning, finish turning, screw cutting, drilling, reaming, tapping, milling, planing and shaping. This trio of publications will prove indispensable to all users of Firth-Vickers corrosion- and heat-resisting steels.

The Attack of Hot Gases on Steel

(*Concluded from page* 196.)

Attack in Various Gases

Oxidation in pure oxygen does not differ in any material particular from that occurring in air. With very low oxygen concentrations the scaling process is changed in that, as a result of the partial pressure of the oxygen approaching the dissociation pressure of ferric oxide, a two-zone scale only is produced. So far as the conditions obtaining in air are concerned it may be said that up to a temperature of about 1,000 deg. C. nitrogen has no marked effect on the scaling and diffusion phenomena involved. At very high temperatures, however, reactions occur with nitrogen that may have a determining effect on the endurance of the metal.

The mechanism of scale formation does not change when the participating oxygen is first produced by chemical reaction at the surface of the steel, provided the other products of the reaction exert no appreciable effect. Such conditions are operative in superheated steam. In such cases, however, the rate of attack, compared with that in air, is markedly increased, and iron and unalloyed steel in superheated steam temperatures above 500 deg. C. have a rate of scaling 50 to 100 per cent. greater than is normal in air at the same temperature. The scaling properties, in air, of the low-alloy steels used in boiler construction can be greatly improved up to 700 deg. C. by additions of Cr and Si up to 3 and 1.5 per cent., respectively, but the advantages of these additions are not obtained in the steam atmosphere, as shown in Fig. 4. Only with higher alloy contents is an appreciable improvement achieved, as, for example, in steel 3 of Fig. 4. Actually, modern practice has shown that for high pressure superheaters working at 500 deg. C. with a pressure of 1,400 lbs. per sq. in., high-alloy steel with about 6 per cent. Cr is unnecessary, contrary to original estimates. In a wide variety of recent installations in Germany, a steel with about 0.9 per cent. Cr, 0.5 per cent. Mo and 0.5 per cent. Si has been used with complete success, and has, in fact, been made a specified material for high-pressure steam conduits. It cannot be said what increase in steam temperatures and pressures would make the use of a more highly-alloyed steel imperative, or to what extent a slightly-increased alloy content in the steel mentioned would satisfy the requirements. The satisfactory service behaviour of the steel mentioned tends to show that the experimental conditions in the laboratory tests were too severe. Under working conditions the oxide layer formed on the inside of the tubes as a result of the decomposition of the steam is not being continually removed, but is sufficiently adherent in the low-alloy steel to confer adequate durability in the atmosphere and temperature prevailing.

Scaling in Steam

The reason for the disparity between the rates of scaling in air and steam is difficult to explain. All that has been ascertained is that a more porous type of scale is formed when steam is the attacking atmosphere. Chrome-silicon steels, similar to steels 2 and 3 in Fig. 4, form a very dense scale of hardly measurable thickness up to temperatures of 700 to 800 deg. C. in air, but the porous film formed in steam only begins to sinter at 700 to 800 deg. C., so that, as in silicon steels in air, a minimum rate of attack is found at these temperatures. The alteration in the structure of the scale may be due to the known influence of hydrogen on the many allotropic transformations in silica and silicates. The possibility also exists that hydrogen is liberated in an explosive manner that may render the scale porous or may alter its chemical composition in some way, but no evidence in support of these hypotheses can be advanced as yet.

It may be mentioned that in high-pressure steam systems, although a slight decarburisation by oxygen is observed, a similar activity on the part of the hydrogen liberated is never obtained.

In pure carbon dioxide the scaling process is similar to that in air, in that here also a pure oxidising action is operative, the carbon dioxide breaking down into oxygen and carbon monoxide. The rate of attack is somewhat greater than in air, but is not so severe as in steam. The carbon monoxide resulting from the reaction can exert a special influence just as can hydrogen in the case of attack by steam.

Iron and nickel are directly attacked by carbon monoxide at temperatures between 100 and 300 deg. C., under pressures between 700 and 4,200 lbs. per sq. in., volatile carbonyls being formed. The process leads to deep fissures being formed in the steel, which ultimately may take on the appearance of oak bark. At high temperatures carbonyls are not formed, but pure carbon monoxide has a carburising action, although this condition seldom obtains in practice, since carbon monoxide is usually greatly diluted by other gases. Generally, carbon

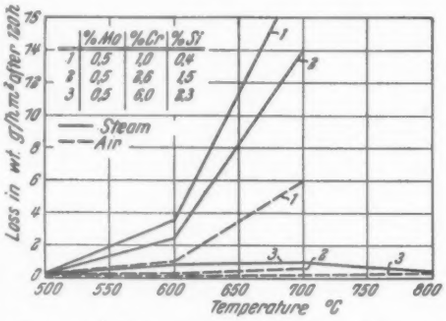

FIG. 4.—COMPARISON OF THE SCALING PROPERTIES OF CR-SI STEELS IN AIR AND IN STEAM.

monoxide occurs in incompletely burnt fuel gas or in gases used to prevent oxidation in bright annealing, and in such cases the temperature is high, but the pressure is normal. In these circumstances the effect of the carbon monoxide can be neglected, since carburising, decarburising and scaling are all determined by the more active constituents of the gas mixture, oxygen, water vapour and carbon dioxide in flue gases, and hydrogen and hydrocarbons in non-oxidising atmospheres.

Attack by hydrogen is of great importance in the synthesis of ammonia and in the other modern high-pressure processes, such as the hydrogenation of coal, oil or tar, for the production of petrol, and the synthesis of methyl alcohol from carbon monoxide and hydrogen. The temperatures in these operations lie between 400 and 600 deg. C. and the pressures between 1,400 and 14,000 lbs. per sq. in. Hydrogen under pressure at elevated temperatures has a strongly-decarburising action on unalloyed steel, methane being the chief reaction product, up to 60 per cent. of this gas being contained in the blisters that frequently form in steel under this treatment. From the nature of the hydrogen attack, it is relatively easy to forecast what alloying elements would increase the endurance of the metal in such an atmosphere. They are those with a strong tendency to form stable carbides that will be reduced with difficulty. Chromium steels with a chromium content of 1 to 6 per cent. and suitable amounts of Ti, V, Mo and Ni show the best resistance to this form of deterioration.

So far as actual scaling in sulphur dioxide is concerned, the oxygen is primarily the controlling factor, since iron and the normal alloying elements have a greater affinity for oxygen than for sulphur. The elements giving the greatest protection in air also increase the resistance to attack by sulphur dioxide. Since sulphur is always present in industrial gases frequently in appreciable concentration, it is essential to consider carefully its effect on all heat-resisting steels, especially those that have found wide application in the construction of furnaces. The danger lies, as mentioned earlier, in the low melting point of the sulphides formed, particularly those of iron and nickel, little being known about chromium sulphide. These melting points are lowered still further by the eutectics that the sulphides form among themselves and with their constituent metals, as shown in Table IV. Sul-

TABLE IV.—*Melting Points of Some Sulphides and Eutectics.*

Sulphide ..	FeS	NiS	Al_2S_3	$Ni-Ni_3S_2$ 22 per cent. S	Fe-FeS 31 per cent. S
Melting point, deg. C. ..	1,190	797	1,100	645	948

phurous gases at high temperatures can thus produce a liquid reaction product that inhibits the formation of a protective film or destroys the efficiency of such a film should that have been formed earlier. Even below the melting point of any combination of sulphides, the solid film, high in sulphide, is extremely permeable, because the atomic mobility is high when the system is only separated by a short temperature interval from its melting point.

The attack of alloyed steel by hydrogen sulphide is much more severe and dangerous than that caused by sulphur dioxide, because the complete absence of oxygen renders impossible the formation of an oxide film, which, although not a complete protection, at least hinders attack. The rate of attack, by hydrogen sulphide, is appreciable at temperatures as low as 400 to 500 deg. C. Chromium has an extremely beneficial effect, from which it must be concluded that the diffusivity of the sulphur in the solid sulphide film is greatly reduced. Aluminium in small quantities has a markedly unfavourable influence, but effects an improvement when present to the extent of more than 6 per cent., and the same holds for silicon. It is not possible to achieve a high degree of resistance to sulphurous gases by the use of steel alloyed with aluminium and silicon in addition to chromium. If the temperature be such that liquid-sulphide eutectics cannot be formed, nickel has no detrimental effect provided the chromium content is adequate, and chromium steels without nickel are not resistant to hydrogen sulphide above about 600 deg. C. These considerations suggest that, on account of the formation of fluid sulphides, or sulphide films of great atomic mobility, the prospects for the developments of a steel resistant to this agent are slight.

So far as industrial gases are concerned, the case of exposure to pure sulphur dioxide or hydrogen sulphide does not arise, since other gases are always present, one of these generally being oxygen. The nature and severity of the attack depends on whether the oxygen content of the gas in question is large or small. With low oxygen concentrations an oxide film can certainly form, but this is easily disturbed by liquid sulphides such as may occur in a high-nickel steel above 650 deg. C. It is, therefore, of the greatest importance to avoid the occurrence of an oxygen deficiency, and excess air should always be allowed to pass into the flue gases. It is worthy of note that nickel-chromium steels are most sensitive to local attack by sulphurous atmospheres deficient in oxygen in the temperature range 700 to 800 deg. C. Large excrescences of scale are formed at corners and edges and deep craters appear in the steel. Microscopical examination shows that the outer layers of scale are composed of oxide, the intermediate layers of oxide and sulphide mixed, and the inner layer of metal interspersed with sulphide eutectic at the

For High Quality Castings

The increasing demand for high-strength close-grained iron castings calls for improved metal. In comparison with the accepted standards of the past, the modern high quality casting requires lower total carbon and phosphorus, with a closer range in silicon. The Ironfounder can now meet this demand at a reasonable cost by the use of Stanton-Dale Refined Pig Iron.

Stanton-Dale is a pig iron of low total carbon, the graphitic carbon being uniformly distributed and of fine curly-flake formation. The close structure ensures remarkably high strength with good machineability, and Tensiles of 16 to 20 tons can readily be obtained when a proportion of Stanton-Dale Iron is introduced.

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The correct grade of Stanton-Dale Iron to use depends on the type and class of castings to be made. The Stanton Technical Service is available to advise on suitable mixtures.

Total Carbon from 2.6 per cent. upwards. *Analysis to individual specification as required.*

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grain boundaries. At higher temperatures attack by liquid sulphides is still evident, but the rate of penetration is not so great. The reason for this may lie in the increased tendency for the sulphides to be oxidised, or in the ability of the metallic solid solution to dissolve sulphur more readily.

The presence of appreciable quantities of oxygen in the sulphur-bearing gas reduces the chance of the oxide coating being locally destroyed by fused sulphides. It is well known that even with a steel containing 25 per cent. Cr and 20 per cent. Ni, good results can only be obtained at high temperatures in a sulphurous atmosphere if an adequate supply of oxygen be present. This is a good example of the decisive part played by oxygen where attack by sulphur may be anticipated. It may be mentioned here that the addition of silicon to nickel-chromium steel, besides reducing the oxygen attack, considerably improves the resistance to sulphur attack by aiding the formation of a dense impermeable oxide coating.

An aggravating factor may be the affinity of the metallic oxides themselves for sulphur, concerning which Table V gives some information.

TABLE V.—*Sulphur Pick-Up by Oxides Heated in Coal-Gas Flame (700 deg. C. Coal Gas with 0·26 mg. S per litre).*

Oxide.	Pick-up, per cent. SO_3.	Time.
CaO	0.6—1.1	1–2 hrs.
MgO	0.23—0.43	1–2 ,,
Al_2O_3	0.2—0.8	1–2 ,,
Fe_2O_3	0.02—0.16	1–3 ,,
NiO	0.15—0.25	2–2½ ,,

It may so happen that special circumstances are operative that make this aspect of the attack by sulphur of the greatest importance. In certain industrial operations it is possible for gases to contain considerable quantities of calcium-carbonate dust, which may deposit on certain portions of the steel structure. Since lime has a high affinity for sulphur, a local concentration of this element is found where the dust is deposited, and very severe local attack may ensue.

Nickel-free heat-resisting steels have, in general, a fair degree of resistance to attack in sulphurous atmospheres, provided these be oxidising. The highest permissible temperature for use, depending on the severity of the other conditions, may be taken as 100 to 200 deg. C., below the maximum working temperature when exposed to air only.

In addition to absorption of sulphur, changes in the carbon content of steel are of some importance. Silicon and aluminium tend to resist carburisation, but chromium behaves rather differently, although high-chromium steels have an excellent degree of resistance to carbon absorption. For many reasons the pick-up of carbon by heat-resisting steels is injurious. The melting point of the steel is lowered and this may account for a serious reduction in the life of electrical-heating elements. In chromium steels the absorption of carbon leads to an impoverishment of chromium available in the steel to form a protective oxide coating, owing to some of the chromium being fixed as carbide.

Chromium resists oxygen decarburisation in steel just as it improves the hydrogen decarburisation properties, by lowering the rate of diffusion of carbon to the surface of the metal, and in addition the penetration of oxygen into the steel is prevented by the formation of very stable chromium oxide at the surface. In certain alloy steels the absorption or abstraction of carbon may result in a structural change. Thus, ferritic steels may become austenitic by carburisation and austenitic steels may be made partly ferritic by decarburisation. One frequent result of such structural changes is the formation of a zone at the surface of the metal composed of very coarse columnar crystals.

In atmospheres of ammonia the gas is decomposed at the surface of the steel, particularly if chromium or aluminium be present, and nitrogen is absorbed in the form of nitride, the modern process of nitrogen hardening being based on this reaction. It may be mentioned that nitrogen absorption may occur in air, in flue gases, and in pure nitrogen at high temperatures, with a consequent alteration in the structure of the metal. Commercial heat-resisting steels, containing in one case 19 per cent. Cr, and 2.3 per cent. Si, and 30 per cent. Cr, and 0.5 per cent. Si in another, have been shown to absorb 0.5 per cent. nitrogen after heating to 1,100 to 1,200 deg. C. for 200 to 1,000 hrs. in air. The steels originally had a ferrite-carbide structure, but after treatment showed an austenitic outer skin with pearlitic and martensitic constituents in the interior. The scaling resistance of chromium steels is not affected by nitrogen absorption, but the same cannot be said of chromium-aluminium steels, since in these aluminium nitride is formed and finally a nitride austenite which has a lower scaling resistance because some of the aluminium is fixed as nitride. In addition the nitride can hinder the free diffusion of the dissolved aluminium to the surface and form a "shadow" in the same way as non-metallic inclusions.

The question of scaling properties cannot be disposed of without a consideration of the metallurgical history of the steel. The smelting operation and the working of the steel are pertinent factors in that they control the uniformity of the metal. Since the whole basis of the heat-resisting steels is to be found in the use of elements with a great affinity for oxygen, the danger is always present that these elements oxidise partially in the manufacturing process and may give rise to segregation of oxides. Such irregularities may influence the progress of scaling. The same argument applies to excessive scaling during mechanical and thermal treatment, with consequent impoverishment of the valuable constituents.

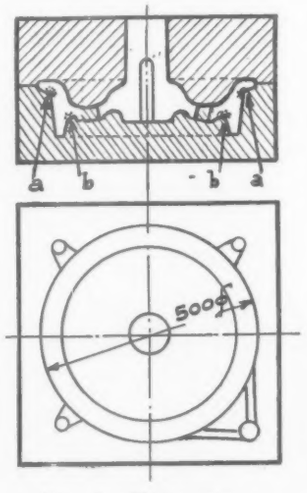


FIG. 1.—MOULD FOR A COLLIERY TUB WHEEL CASTING.

(*Continued from next column.*)

that the internal chills "a," set against the junction of the ribs, had been omitted. The chills appearing to constitute zones of weakness at the places where the streams of metal unite, it was thought desirable to replace them by coke vents *c* set along the length of the ribs and having an outlet through the pipe T. This would allow of the introduction of water, as soon as the castings were teemed. This method has given excellent results, the water playing a double rôle: (1) Rapid cooling of the zones of deep section, giving uniform cooling of the casting, and (2) the wetted sand no longer offers any resistance to the movement of the ribs due to contraction.

Other People's Difficulties

It is always interesting for British moulders to learn just what troubles beset their confrères abroad, and with the object of giving them this insight we have translated two short articles from "La Fonderie Belge," which magazine in each issue (monthly or bimonthly) gives a page or so which it calls "The Practical Man's Corner." The two we have chosen are called "Our Moulding Sand Was Insufficiently Permeable" and "Old Moulders Sometimes Forget Elementary Precautions."

Inadequate Sand Permeability

The job under consideration is shown in Fig. 1, and relates to 20 in. outside dia. colliery tub wheels, made in steel and weighing 143 lbs. Hand moulding using pattern plates was the method employed and Fig. 1 shows the parts carried in the drag and cope half boxes. The runner leads to two tangential in-gates, and three risers on the flange with a feeding head on the boss. The moulds were stoved, but unfortunately all the castings showed surface blowholes at the positions marked *a* and *b* in the sketch. These blowholes ran right around the casting.

In spite of all such precautions as controlled ramming, abundant venting, and the special arrangements for getting gas away from the bottom of the runner, no improvement was shown.

The idea of blowholes arising from the actual metal was untenable since all the castings showed the defect, and not only those from one particular cast. Running methods, a slightly inclined mould, and a lowering of the runner gave some slight improvement, and limited porosity to the regions directly opposite to the riser outlets.

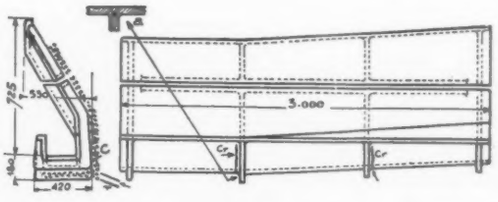


FIG. 2.—A RIBBED STEEL CASTING WHERE COKE VENTS REPLACED CHILLS.

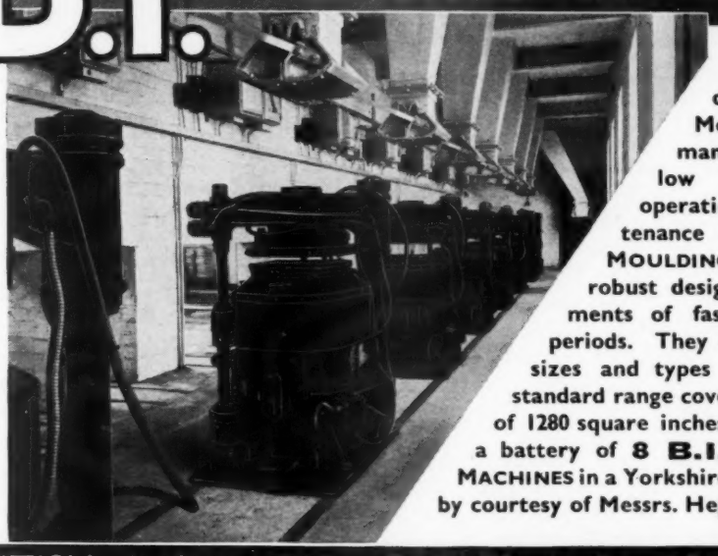
Reverting to casting on the flat, the risers were eliminated and the blowholes reappeared all around once more. Continuing with this method of casting, it was found that by incorporating in the sand mixture a small proportion of large grain sized moulding sand, the whole of the defects disappeared. This seems to show that the blowholes were due to the formation of gas at *a* and *b*, and this gas, because of the low permeability of the sand, tried to find a path through the actual metal.

Coke Vent Replaces Chills

Castings of the type shown in Fig. 2 are a regular production in the author's steel foundry. They seldom give any trouble, and surprises are rare so long as the moulding and casting are correctly carried out. To ensure this, the work is always given out to old and experienced moulders, whose skill is recognised, and so far as possible always to the same moulder. This method always yielded good results, until one day a casting was made which was severely cracked at the placed marked Cr in the sketch (Fig. 2). Seeking for the reason, the manager was assured that nothing had been neglected to ensure the perfect soundness of the casting. The factor responsible was undoubtedly the metal. Taking matters a step further, it was noticed

(*Continued in previous column.*)

B.I. MAGNETIC MOULDING MACHINES *in a* YORKSHIRE FOUNDRY



ELECTRICITY, as the direct power medium for Moulding Machines, has many advantages, including low installation cost, low operating cost and low maintenance cost. **B.I. MAGNETIC MOULDING MACHINES** are of robust design to meet the requirements of fast production over long periods. They can be built for various sizes and types of moulding boxes, the standard range covering boxes up to an area of 1280 square inches. The illustration shows a battery of **8 B.I. MAGNETIC MOULDING MACHINES** in a Yorkshire Foundry, and is published by courtesy of Messrs. Hepworth and Grandage Ltd.

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The Week's News in Brief

Trade Talk

THE NATIONAL UNION OF FOUNDRY WORKERS is to hold a delegate conference at the Empire Exhibition on October 1.

IT IS UNDERSTOOD that the plant which the British Aluminium Company, Limited, is to erect at Newport, Mon, will be built in co-operation with Swiss and Canadian interests.

ALUMINIUM UNION, LIMITED, are removing on September 29 from their present offices at Bush House, to the Adelphi, Strand, W.C.2, and their new telephone number will be Temple Bar 7766.

THREE BELLS for the new liner "Queen Elizabeth" are to be made by J. Taylor & Company, of Loughborough. Lloyds are presenting these bells to the ship, as they did in the case of the "Queen Mary."

IT IS NOW ANNOUNCED that the Iranian Ministry of Industry has placed an order with Demag A.G., of Duisburg, to a value of 30,000,000 Rmk. for the erection and equipment of an iron and steel works in Iran. The contract is shared with Fried. Krupp A.G., Essen.

THE REPORT from the Hauts Fourneaux de Saulnes that pig-iron output in January to June at 78,413 tons was 9,064 tons less than in the parallel period of 1937 reflects the recession in the French iron and steel industry this year. A similar decline occurred in iron-ore output, from 677,420 tons to 536,794 tons.

EMPLOYMENT FOR AN EXTRA 300 men will be provided in Lochaber with the now completed third development of the British Aluminium Company's Lochaber power works. To provide accommodation for the additional workers 150 houses are being added to the company's village of Inverlochy, and a special hostel to house 250 single men is being provided.

FERGUSON BROS. (PORT GLASGOW), LIMITED, launched last week the single-screw twin-grab hopper dredger "Foulney," which they have built for the L.M.S. Railway. The vessel is for service at Barrow, and has a hopper capacity of 690 tons. The main propelling machinery is a set of triple-expansion engines, built by Ferguson Bros., and one marine return-tube boiler.

A PROGRESS REPORT by the directors of General Refractories, Limited, states that the seriously diminished output of steel has been reflected in a reduction of sales of refractories, but, thanks largely to the demand for its products from other markets, the group has been able substantially to maintain the total volume of its sales, as compared with the equivalent figures for 1937. The accounts for the first six months of the current year indicate that the trading profits of the group do not fall far short of those earned during the same period of last year.

THE NEW ZEALAND GOVERNMENT'S plans to establish a State iron and steel industry in the Dominion, already the subject of much criticism on economic grounds, may prove ill-founded on another score. It is now rumoured that the deposits of iron ore at Onekaka, where the works are to be established, are much smaller than was believed. The only extensive investigation of the field was made by a Government geological survey before the war. It is now believed that the rough estimate of 68,000,000 tons of iron ore then made is very wide of the mark and that even a third of that quantity might be an optimistic estimate. When this question was referred to the Minister of Industries and Commerce, he admitted that at the moment it appeared that the previous estimate had been excessive. However, it was as yet too early to draw conclusions and many months must elapse before definite opinions could be formed. At present an exhaustive survey of the area at Onekaka is being made, and also at Parapara, a few miles away.

Contracts Open

Berwick-on-Tweed, October 8.—Supply and erection of iron fencing and gates, for the Town Council. The Borough Surveyor, Municipal Buildings, Wallace Green, Berwick-on-Tweed.

Newport, Mon., September 26.—Cast-iron and steel pipes and specials, for the Town Council. Mr. W. W. Marsden, engineer, Crown Arcade, Newport, Mon. (Fee £3 3s., returnable.)

Obituary

MR. THOMAS RAMSAY, member of an old Whitehaven ironfounding family, died on Friday, September 9. He was 66 years of age.

MR. NORMAN BLACKLEY, a member of the Glasgow firm of Blackley, Inglis & Company, Limited, iron and steel merchants, died suddenly at Harrogate on September 12.

MR. ARTHUR E. BARFIELD, who died on Thursday last at his home at Chalfont St. Giles, Bucks, at the age of 74, was one of the founders of Wild-Barfield Electric Furnaces, Limited, and had been chairman of the company since its incorporation in 1917. He was also a director of the associated company, G.W.B. Electric Furnaces, Limited.

WE REGRET to announce the death of Mrs. Athey, wife of Major J. W. Athey, managing director of the Fordath Engineering Company, Limited, which occurred at The Headland, Little Aston Park, Sutton Coldfield, last Friday. Mrs. Athey was well known to many members of the Institute of British Foundrymen, as she regularly attended the annual conferences.

WE REGRET TO ANNOUNCE that Mr. William R. Barclay died at his home in Birmingham on September 16, at the age of 63. Mr. Barclay was one of the outstanding authorities on non-ferrous metal-

MR. WILLIAM R. BARCLAY.

lurgy in this country. Educated privately, Mr. Barclay at the age of 18 attended the Sheffield Technical College (now the University of Sheffield), where later he became a part-time lecturer. He was an Honours Silver Medallist in electro metallurgy at the City and Guilds of London Institute, and became an associate member of the Institute of Electrical Engineers in 1900. During the years 1893-1912 he successively acted as assistant to the works manager of Mappin Bros., Sheffield, and the works manager and technical adviser to Joseph Rodgers & Sons. From 1910-1919 he was lecturer in electro metallurgy at Sheffield University, whilst from 1912-1928 he was Joint Examiner in this subject to the City and Guilds of London. During the war, Mr. Barclay became chief metallurgist and assistant director to the Non-Ferrous Rolled Metal Section, and technical director of the Electro-Metallurgical Committee of the Ministry of Munitions. He was awarded the O.B.E. for his distinguished services during the war. During this period Mr. Barclay revived the idea of utilising electric furnaces for the melting of cupro-nickel alloys, and an arrangement was made with Henry Wiggin & Company, Limited, of Birmingham, for collaboration in the rolling of electrically-melted metal. In 1928, Mr. Barclay became managing director of the Henry Wiggin concern, and in 1931 he was appointed consulting metallurgist to the Mond Nickel Company, Limited. During his association with the Mond Nickel Company, Mr. Barclay was largely instrumental in initiating the company's now well-known research and development organisation. Mr. Barclay was associated with the Copper Development Association from its inception. In 1936 he was elected President of the Institute of Metals, and was re-elected to serve a further term in 1937. It was during his presidency that the Institute decided to award an annual medal for outstanding services to non-ferrous metallurgy, the first award being made this year to Sir William Bragg, O.M., D.Sc., F.R.S. Mr. Barclay was well-known in metallurgical circles in U.S.A., and was invited to deliver the Calvin W. Rice lecture to the American Society of Mechanical Engineers in June of this year. At the same time, he was to be awarded the degree of Doctor of Science by the Stevens Institute of Technology. Unfortunately, owing to his illness, Mr. Barclay was unable to attend these functions. The funeral, which took place at Birmingham last Monday, was attended by a large number of well-known metallurgists.

MR. HEREWARD I. BRACKENBURY, of Tweedhill, Berwick, Northumberland, who retired a few days ago from the board of directors of R. & W. Hawthorn, Leslie & Company, Limited, Hebburn and Newcastle-upon-Tyne, died last Saturday, aged 67. Mr. Brackenbury was apprenticed to engineering at the Elswick Works, Scotswood, Newcastle, in 1886. In 1918 he was awarded the C.B.E.

Personal

MR. G. J. SCOTT has been appointed chairman of Laurence Scott & Electromotors, Limited, in place of the late Mr. W. H. Scott.

MR. MARK BURTON has been appointed joint managing director of Marshall, Sons & Company (Successors), Limited, of Gainsborough. Mr. Burton has had over forty years' experience of the business conducted by Marshalls at the Britannia Iron Works, and on the acquisition of this concern by Thos. W. Ward, Limited, of Sheffield, he was appointed general manager, which position was confirmed by the board of the present company, by whom he was invited to a seat on the board soon after the company was floated.

MR. R. F. JACKSON has been appointed joint managing director of Luke & Spencer, Limited, manufacturers of grinding machinery and abrasive wheels, of Broadheath, near Manchester. Mr. Jackson, who has had a life-long connection with the company, was a partner in the firm of Sturrock & Jackson, who acted as agents for Luke & Spencer, Limited, in the North and Midlands for the past 14 years. Mr. A. D. Sturrock is retiring but retaining his seat on the board. Mr. Jackson returns to the works on October 1, when all sales will be controlled from Broadheath.

New Companies

(From the Register compiled by Jordan & Sons, Limited, Company Registration Agents, 116 to 118, Chancery Lane, London, W.C.2.)

Metallurgical Engineers, Limited, 14, Old Queen Street, London, S.W.1.—Capital £500.

Spectral Non-Ferrous Metals, Limited.—Capital £1,000. Subscribers: P. Edwards and A. Scott, 33, Southampton Street, London, W.C.2.

Fuelsaver Cylinder Heads, Limited, 14-16, Dorland House, Regent Street, London, S.W.1.—Capital, £1,500. Manufacturers of aluminium cylinder heads for internal-combustion engines. Directors: J. A. Masters and H. R. Pope.

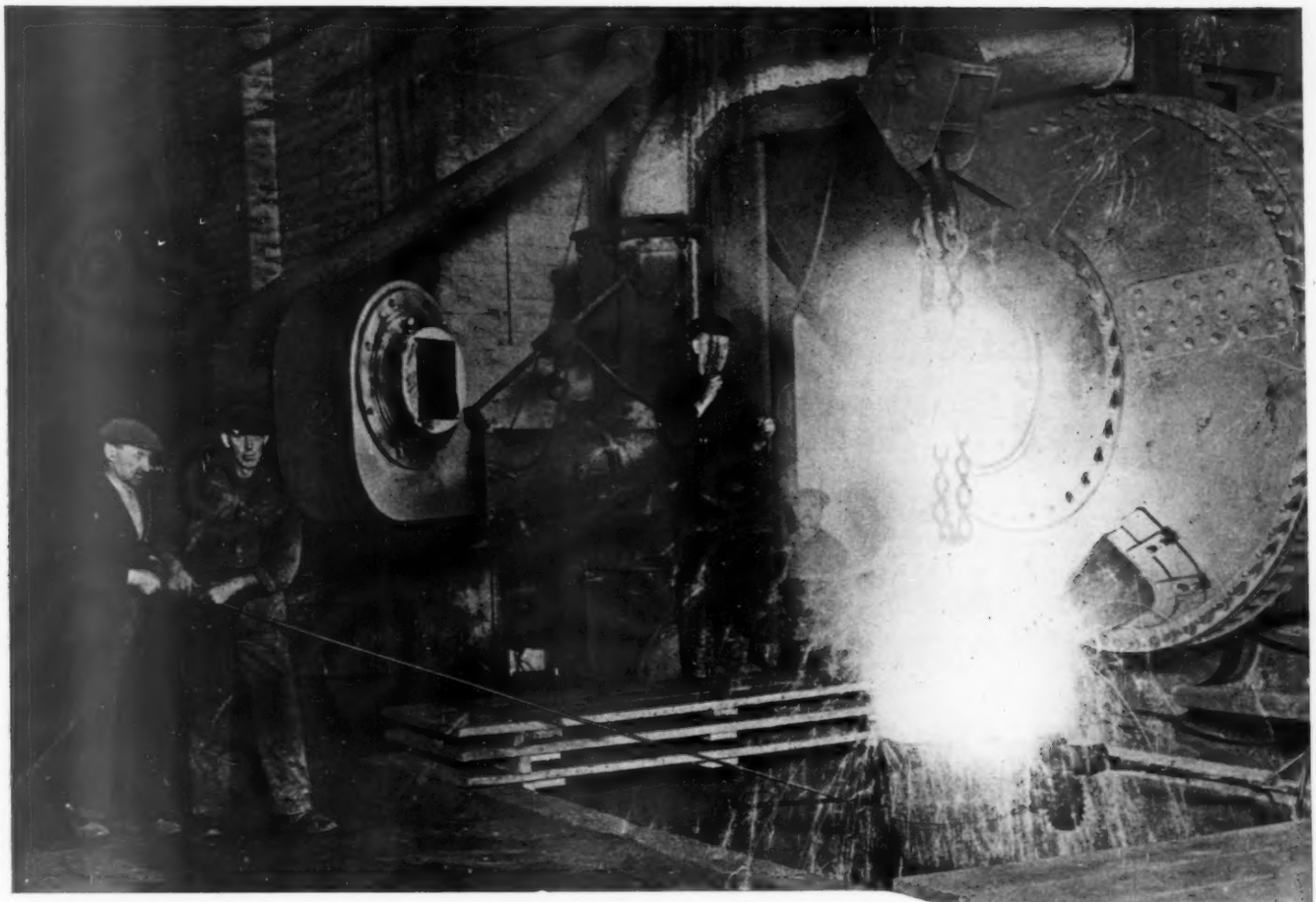
Company Reports

Vickers, Limited.—Interim dividend of 4 per cent., less tax.

Hale & Hale (Tipton), Limited.—Dividend of 7½ per cent. for the year to June 30.

R. & W. Hawthorn, Leslie & Company, Limited.—Net profit for the year ended June 30, £77,377; brought in, £23,296; dividend of 9 per cent., £48,367; to general reserve, £24,137; carried forward, £28,169.

CANADA'S PRODUCTION OF PIG-IRON in January to June totalled 404,158 tons, as against 423,944 tons in the parallel period of 1937. The output of steel ingots was 670,741 tons, against 713,177 tons.



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Raw Material Markets

There has been little activity in the iron and steel markets recently, owing to the lack of information regarding prices. Further, the international situation has not encouraged buyers to enter into contracts. Given normal conditions, the outlook is not unsatisfactory, and it is believed that most consumers will be forced into the market after the turn of the year. It is understood that the Emergency Committee of the British Iron and Steel Federation has deferred a decision on the question of steel scrap prices until its October meeting. Presumably, current prices will continue to rule until a further announcement has been made.

Pig-Iron

MIDDLESBROUGH.—Business continues to be on a small scale. Many consumers of foundry iron have still heavy tonnages to take up under existing contracts, but others are now in the position to purchase additional supplies. Until prices for delivery after the turn of the year have been announced, trade will continue on present lines. Any new orders are for prompt despatch and involve only small tonnages. No. 3 Cleveland G.M.B. foundry iron is currently quoted at 109s. per ton, delivered on Tees-side or at Falkirk, 111s. on the North-East Coast, and 112s. on the Clyde.

With heavy stocks on hand, producers of East Coast hematite are finding it difficult to maintain the current output. Most users are not well situated for work and are having to reduce their deliveries to a minimum. It is certain that consumers will not buy further tonnages until after the end of the year, as prices are fixed until then. The state of the export market is still disappointing. In view of the position last year, when producers in this country were able to send only small tonnages to overseas consumers, this is perhaps not to be wondered at, and it is feared that many foreign buyers who had to look elsewhere for supplies then are now completely lost to the British market. There has been some improvement this week, however, and shipments of 500 tons and 1,000 tons have been despatched to France and Czecho-Slovakia respectively. Export prices are considerably below home quotations.

LANCASHIRE.—Apart from the heavy electrical engineers and the machine-tool trade, who are well employed, the foundry iron market in this area is still quiet. Most users are well covered for supplies, but many are not in the position to take up full contract deliveries. The condition of the light-castings trade remains disappointing, and there is unlikely to be any material improvement in this section for some time, as the building trade, which takes up a large proportion of the output of castings, is now entering upon its normal seasonal slack period. For delivery in the Lancashire price zone, offers of Derbyshire and Staffordshire brands of No. 3 foundry iron are on the basis of 114s. per ton, less 5s. rebate, and Northamptonshire is at 112s. 6d. Derbyshire forge iron is offered at from 111s. to 113s., according to the class of consumer. The hematite market is quiet, and consumers do not require their full contract deliveries. West Coast hematite is at 141s., with East Coast material at 140s. 6d.

MIDLANDS.—New inquiries for foundry iron continue to be few and for small tonnages for early requirements. Although most users have large stocks on hand, others would take up additional supplies if the price situation were clearer. Thus, present conditions are likely to exist until prices are reviewed at the end of the year. Consumers are hoping for substantial reductions on present quotations. A fair trade is being done in low-phosphorus iron, and the heavy engineering concerns are especially active in this section. Prices range from £5 10s. to £6 12s. per ton. There is little change to report in hematite; consumers are still unable to accept full deliveries, but the outlook is not unsatisfactory, and it is believed that better conditions will prevail in the autumn.

SCOTLAND.—Consumers are marking time in this area. Being well covered, most users can afford to wait until prices are revised at the end of December, while others are taking up only small tonnages. Prices remain at 120s. 6d. for No. 1 and 2s. 6d. less for No. 3, f.o.t. furnaces. Although the steelworks are active, it is taking them a long time to use up all of their iron and little business is emanating from this source. Hematite mixed numbers are quoted at 133s., Scottish basic 107s. 6d. and English and Indian basic 100s., all less 5s. per ton rebate, delivered local steelworks.

Coke

Forward buying in the foundry-coke market is not favoured, and the end of December appears to be the limit, while other consumers are buying from week to week. Owing to the possibility of adverse weather coming shortly, some consumers have recently ordered additional tonnages. For delivery to Birmingham and Black Country stations, best Durham coke is quoted at a minimum of 50s. 6d., with Welsh at from 50s. 6d. upwards, according to analysis.

Steel

The steel market has been overshadowed by the international crisis, but the undertone has been firm and there are indications that overseas buyers have awakened to the risks of allowing their stocks to become depleted, says the official report of the London Iron and Steel Exchange. In the home market more business has been moving in several departments than for some time. Trading in the semi-finished steel market, also, has developed greater activity, although there is still room for a considerable expansion in the demand. The process of the absorption of stocks is progressing steadily, and there are indications that the usual autumn expansion in the demand is approaching. The situation in the finished-steel section of the market is irregular. The heavy-steel makers have still a considerable tonnage of work in hand, but their reserve of orders has been greatly reduced. Conditions in the lighter branches of the industry have shown some improvement, but there is a fair amount of unemployed plant. The inquiry from overseas, however, has been on a larger scale than for some time.

Scrap

As announced above, no decision with regard to steel scrap prices will be made until October, owing to the unsettled political situation. Current prices were due to expire on September 30, but it is thought that they will now remain in operation until the next meeting (some time in October) of the Emergency Committee of the British Iron and Steel Federation. Quiet conditions continue to rule in all sections of the iron and steel scrap market.

Metals

The international situation has continued to cause disquiet in metals and, apart from orders from the armament makers, little new business has been transacted. There has been a firmer undertone in the last few days, however.

Copper.—World stocks of refined copper decreased during the month of August by about 28,000 short tons, to 495,000 tons. An increase in the world stocks of blister copper was recorded and the total was about 2,000 tons higher on the month. Apparent consumption increased by about 10,000 tons to 178,000 tons, the United States accounting for about 7,000 tons of this amount. Business during the past week has been restricted almost entirely to the armament manufacturers, who have recently taken up large tonnages. The outlook for copper, of course, depends on a satisfactory settlement of the Czecho-Slovakian situation, but it is fairly certain that business in this market will continue to be largely for munitions for some time to come. In the United States, the price of domestic copper has been further advanced and is now quoted at 10⅜ cents per lb., while the price of scrap has been raised to 8⅞ cents per lb. The higher quotations have been responsible for considerably more active conditions recently.

Metal Exchange quotations were as follow :—

Cash.—Thursday, £42 11s. 3d. to £42 12s. 6d.; Friday, £42 13s. 9d. to £42 15s.; Monday, £43 7s. 6d. to £43 8s. 9d.; Tuesday, £42 16s. 3d. to £42 17s. 6d.; Wednesday, £42 10s. to £42 11s. 3d.

Three Months. — Thursday, £42 15s. to £42 16s. 3d.; Friday, £42 16s. 3d. to £42 17s. 6d.; Monday, £43 11s. 3d. to £43 12s. 6d.; Tuesday, £42 18s. 9d. to £43; Wednesday, £42 13s. 9d. to £42 15s.

Tin.—A firm tone has ruled in this market during the past week and prices have been stronger. On Monday the quotation was the highest recorded so far this year. As in the case of other metals, a fair proportion of the business has been with the armament makers. The weekly market report issued by Rudolf Wolff & Company states that " business with consumers has been only moderate in this country, but rather more demand is reported from the Continent. In the United States, after a quiet opening, some improvement took place, with buyers reported to be displaying a more active interest. Having in view the tendency for the industrial situation in America to improve and the fact that buyers have, generally speaking, run their supplies down to a fairly low level, there seems reasonable scope for some further advance in prices, especially having in view the control exercised over output and the consequent further favourable development of the statistical position."

Official quotations were as follow :—

Cash.—Thursday, £195 5s. to £195 10s.; Friday, £194 10s. to £194 15s.; Monday, £196 5s. to £196 10s.; Tuesday, £195 15s. to £196; Wednesday, £195 5s. to £195 10s.

Three Months.—Thursday, £196 to £196 5s.; Friday, £195 10s. to £195 15s.; Monday, £197 to £197 5s.; Tuesday, £196 10s. to £196 15s.; Wednesday, £196 to £196 5s.

Spelter.—Buying in this market has been quite active at times during the week. On Friday the turnover amounted to about 4,700 tons. It is reported that negotiations are now progressing to achieve agreement among zinc producers upon some degree of co-operation which will ensure curtailment of output. The formation of a Cartel appears to be very remote, but it is thought that something will be done after the style of the Lead Producers' Association.

Daily market prices :—

Ordinary. — Thursday, £14 5s.; Friday, £14 16s. 3d.; Monday, £14 15s.; Tuesday, £14 5s.; Wednesday, £14 6s. 3d.

Lead.—Since lead producers outside of the United States formed an association with the object of controlling the output, the tone of the market has steadily improved. There was an improvement in the value of building plans approved in August as compared with a year ago. The total figure at £6,302,100 was 8.7 per cent. above the returns of August, 1937.

Day-to-day quotations :—

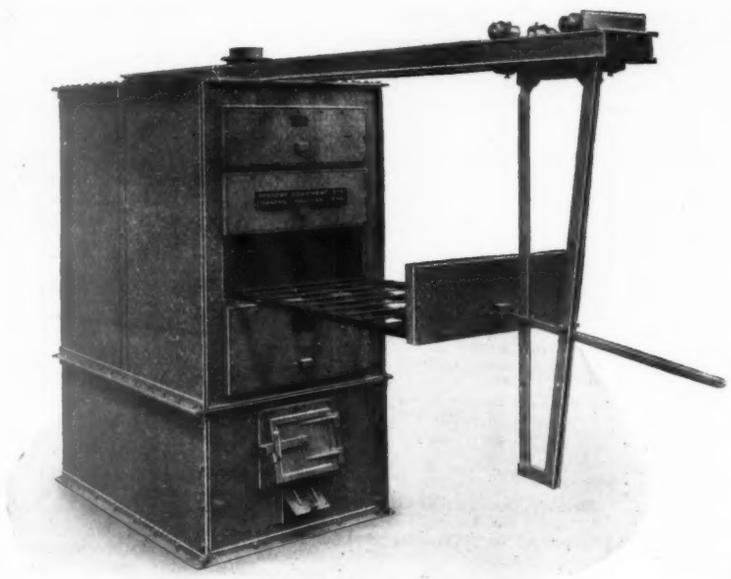
Soft Foreign (Prompt).—Thursday, £15 15s.; Friday, £15 16s. 3d.; Monday, £16 2s. 6d.; Tuesday, £16; Wednesday, £15 17s. 6d.

Scrap.—There has been a better demand for most descriptions of scrap recently, despite the unsettled outlook. Exports have been well maintained.

Approximate selling prices for old metal:—New aluminium cuttings, £66; rolled, £52; cast, £28; foil, £88 to £90. Copper, £37 to £41; braziery, £34. Brass (clean), £21 to £25. Zinc, £9. Lead, £14. Gunmetal, £39.

A New Hard Alloy

According to a note in the latest issue of the Bulletin of the Russo-British Chamber of Commerce, the Hard Alloys Combine of Moscow has mastered the production of a new hard alloy, which is designated RE3. Tests with hard and brittle materials, such as chrome-nickel cast iron, glass, babbitt, etc., gave good results, and as regards hardness the new alloy is claimed to be not inferior, and in some respects superior, to the best foreign alloys. At the Chelyabinsk Tractor Works cutting tools made from the alloy machined 22 to 26 cast iron parts without re-sharpening, instead of 10 to 15 parts by certain well-known imported alloys. It is further stated that RE3 is also successfully applied in " diamond " grinding of parts, whilst drills for drilling glass are also being made from it, displacing diamond drills.



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LONDON — MANCHESTER — GLASGOW — NEWCASTLE
CARDIFF — BIRMINGHAM — BRISTOL — DUBLIN

RAW MATERIALS—PRICE LIST

(Wednesday, September 21, 1938)

COPPER

	£	s.	d.
Standard cash	42	10	0
Three months	42	13	9
Electrolytic	48	0	0
Tough	47	5	0
Best selected	47	15	0
Sheets	80	0	0
India	60	7	6
Wire bars	49	0	0
Ingot bars	49	0	0
H.C. wire rods	52	10	0
Off av. cash, August	40	12	8 1/2
Do., 3 mths., August	40	18	0 21/44
Do., Sttlmnt., August	40	12	10 1/11
Do., Electro, August	46	6	5 1/11
Do., B.S., August	46	1	4 3/8
Do., Wire bars, August	46	14	9 3/11
Solid drawn tubes			12 1/2d.
Brazed tubes			12 1/2d.
Wire			8 1/2d.

BRASS

Solid drawn tubes	11 1/2d.
Brazed tubes	13 1/2d.
Rods, drawn	9 1/2d.
Rods, extd. or rlld.	5 1/2d.
Sheets to 10 w.g.	8 1/2d.
Wire	8 1/2d.
Rolled metal	8 1/2d.
Yellow metal rods	5 1/2d.

TIN

	£	s.	d.
Standard cash	195	5	0
Three months	196	0	0
English	195	5	0
Bars	197	15	0
Straits (nom.)	203	15	0
Eastern	203	0	0
Banca (nom.)		—	
Off. av. cash, August	193	2	6
Do., 3 mths., August	194	2	6
Do., Sttlmt., August	193	3	4 10/11

SPELTER

	£	s.	d.
Ordinary	14	6	3
Remelted	12	10	0
Hard	9	10	0
Electro, 99.9	18	7	6
English	15	12	6
India	13	10	0
Zinc dust	17	5	0
Zinc ashes	3	15	0
Off. aver., August	13	11	5 1/2
Aver., spot, August	13	9	4 7/44

LEAD

	£	s.	d.
Soft foreign, ppt.	15	17	6
Empire (nom.)	16	16	3
English	18	0	0
Sheets, home	23	5	0
Do. export	19	17	6
Pipes, home	22	15	0
Do. export	20	10	0
Tea lead	32	0	0
Off. aver., August	14	8	6 3/8
Aver., spot, August	14	7	4 11/44

ALUMINIUM

Ingots	£94
Wire	1/3 to 1/4 lb.
Sheet and foil	1/2 1/2 to 1/4 lb.

ZINC SHEETS, &c.

	£	s.	d.		£	s.	d.
Zinc sheets, English	29	5	0	to 29	15	0	
Do., V.M. ex-whse.	29	5	0	to 29	15	0	
Rods				18	0	0	

ANTIMONY

	£	s.	d.		£	s.	d.
English	70	0	0	to 71	0	0	
Chinese, ex-whse.				50	0	0	
Crude, c.i.f.				35	0	0	

QUICKSILVER

	£	s.	d.
Quicksilver	13	15	0

FERRO-ALLOYS AND STEEL-MAKING METALS

Ferro-silicon—						
25%	12	10	0			
45/50%	12	10	0			
75%	17	0	0			
Ferro-vanadium—						
35/50%	14/- lb. Va.					
Ferro-molybdenum—						
70/75% carbon-free	4/9 lb. Mo.					
Ferro-titanium—						
20/25% carbon-free	9d. lb.					
Ferro-tungsten—						
80/85%	4/8 lb.					
Tungsten metal powder—						
98/99%	4/9 1/2 lb.					
Ferro-chrome—						
2/4% car.	34	15	0			
4/6% car.	24	5	0			
6/8% car.	24	0	0			
8/10% car.	24	0	0			
Ferro-chrome—						
Max. 2% car.	36	0	0			
Max. 1% car.	38	5	0			
Max. 0.5% car.	41	0	0			
70% carbon-free	10d. lb.					
Nickel—99.5/100%	£180 to £185					
"F" nickel shot	£165	0	0			
Ferro-cobalt, 98/99%	8/6 to 8/9 lb.					
Metallic chromium—						
96/98%	2/5 lb.					
Ferro-manganese—						
76/80% loose	£18	15	0	to 19	5	0
76/80% packed	£19	15	0	to 20	5	0
76/80% export	£16	0	0	to 17	0	0
Metallic manganese—						
94/96% carbon-free	1/3 lb.					

Per ton unless otherwise stated, basis 2-ton lots, d/d Sheffield works.

SCRAP

	£	s.	d.		£	s.	d.
South Wales (West)—							
Heavy steel, best	3	8	9	to 3	11	3	
Mixed iron and steel	3	6	9	to 3	9	3	
Heavy cast iron	3	8	9	to 3	11	3	
Good machinery	3	7	6	to 3	12	6	
Cleveland—							
Heavy steel, best	3	7	0	to 3	9	6	
Steel turnings	2	13	0	to 2	15	6	
Heavy cast iron				3	5	0	
Heavy machinery				3	10	0	
Midlands—							
Short heavy steel	3	5	0	to 3	7	6	
Light cast-iron scrap	2	12	6	to 2	15	0	
Heavy wrought iron				3	15	0	
Steel turnings	2	6	3	to 2	8	9	
Scotland—							
Heavy steel, best	3	5	0	to 3	7	6	
Ordinary cast iron	3	7	6	to 3	8	6	
Cast-iron borings	2	0	6	to 2	3	0	
Wrot-iron piling	3	15	0	to 3	17	6	
Heavy machinery	3	12	6	to 3	15	0	

London—Merchants' buying prices, delivered yard.

	£	s.	d.
Copper (clean)	34	0	0
Brass	20	0	0
Lead (less usual draft)	14	10	0
Tea lead	11	0	0
Zinc	8	10	0
New aluminium cuttings	55	0	0
Braziery copper	31	0	0
Gunmetal	34	0	0
Hollow pewter	140	0	0
Shaped black pewter	95	0	0

HIGH-SPEED TOOL STEEL

Finished bars, 14% tungsten	3s. 0d.
Finished bars, 18% tungsten	3s. 10d.

Per lb. d/d buyers' works.

PIG-IRON*

N.E. Coast (d/d Tees-side area)—	
Foundry No. 1	111/6
" No. 3	109/-
" No. 4	108/-
Forge No. 4	108/-
Hematite No. 1	133/-
Hematite M/Nos.	132/6
N.W. Coast—	
Hem. M/Nos. d/d Glas.	133/-
" d/d Birm.	144/6
Midlands (d/d Birmingham dist.)—	
Staffs No. 4 forge	110/-
" No. 3 fdry.	111/-
Northants forge	107/6
" fdry. No. 3	108/6
" fdry. No. 1	111/6
Derbyshire forge	110/-
" fdry. No. 3	111/-
" fdry. No. 1	114/-
Scotland—	
Foundry, No. 1, f.o.t.	120/6
" No. 3, f.o.t.	118/-
Cleveland No. 3, Glasgow	112/-
" Falkirk	109/-
Scottish hem. M/Nos. d/d	133/-
Sheffield (d/d district)—	
Derby forge	107/6
" fdry. No. 3	108/6
Lincs forge	107/6
" fdry. No. 3	108/6
W.C. hematite	138/6
Lancashire (d/d eq. Man.)—	
Derby fdry. No. 3	114/-
Staffs fdry. No. 3	114/-
Northants fdry. No. 3	112/6
Cleveland fdry. No. 3	114/-
Glengarnock, No. 3	137/6
Clyde, No. 3	137/6
Monkland, No. 3	137/6
Eglinton, No. 3	137/6
Gartsherrie, No. 3	137/6
Shotts, No. 3	137/6

(* Prices of hematite and basic pig-iron, and of foundry and forge iron with a phosphoric content of not less than 0.75 per cent., are subject to a rebate of 5s. per ton under certain conditions.)

* FINISHED IRON AND STEEL

Usual district deliveries.

[A rebate of 15/- per ton for steel bars, sections, plates, joists and hoops is obtainable in the home trade under certain conditions.]

Iron—	£	s.	d.		£	s.	d.
Bars (cr.)	13	5	0	to 13	15	0	
Nut and bolt iron	11	12	6	to 12	2	6	
Hoops				14	2	6	
Marked bars (Staffs) f.o.t.				15	15	0	
Gas strip				14	2	6	
Bolts and nuts, 1/2 in. × 4 in.				17	10	0 and up	
Steel—							
Plates, ship, etc.	11	8	0	to 11	10	6	
Boiler plts.	11	18	0	to 12	0	6	
Angles				11	0	6	
Tees				12	0	6	
Joists				11	0	6	
Rounds and squares, 3 in. to 5 1/2 in.				12	0	6	
Rounds under 3 in. to 1/4 in. (untested)				12	4	0	
Flats—8 in. wide and over				11	5	6	
" under 8 in. and over 5 in.				11	10	6	
Rails, heavy				10	2	6	
Fishplates				14	2	6	
Hoops (Staffs)				12	19	0	
Black sheets, 24g. (4-t. lots)				15	15	0	
Galv. cor. shts. (")				18	10	0	
Galv. flat shts. (")				19	0	0	
Galv. fencing wire, 8g. plain				20	5	0	
Billets, soft, 100-ton lots				7	17	6	
Sheet bars				7	15	0	
Tin bars				7	15	0	

PHOSPHOR BRONZE

	Per lb. basis
Strip	11 1/2d.
Sheet to 10 w.g.	11 3/4d.
Wire	13 1/2d.
Rods	13 3/4d.
Tubes	18 1/2d.
Castings	15d.

Delivery 3 cwt. free.
10% phos. cop. £33 above B.S.
15% phos. cop. £38 above B.S.
Phosphor tin (5%) £30 above price of English ingots.
C. CLIFFORD & SON, LIMITED.

NICKEL SILVER, &c.

	Per lb.
Ingots for raising	7d. to 1/1
Rolled—	
To 9 in. wide	1/1 to 1/7
To 12 in. wide	1/1 1/4 to 1/7 1/4
To 15 in. wide	1/1 1/2 to 1/7 1/2
To 18 in. wide	1/2 to 1/8
To 21 in. wide	1/2 1/2 to 1/8 1/2
To 25 in. wide	1/3 to 1/9
Ingots for spoons and forks	7d. to 1/3 1/2
Ingots rolled to spoon size	10d. to 1/6 1/2
Wire round—	
to 10g.	1/4 1/2 to 1/11 1/2

with extras according to gauge.
Special 5ths quality turning rods in straight lengths, 1/3 1/2 upwards.

AMERICAN IRON AND STEEL

At Pittsburgh unless otherwise stated.

	Dols.
No. 2 foundry, Phila.	21.84
No. 2 foundry, Valley	20.00
No. 2 foundry, Birm.	16.38
Basic, Valley	19.50
Malleable, Valley	20.00
Grey forge, Valley	19.50
Ferro-mang. 80%, seaboard	92.50
O.-h. rails, h'y, at mill	42.50
Billets	34.00
Sheet bars	34.00
Wire rods	43.00
	Cents.
Iron bars, Chicago	2.15
Steel bars	2.25
Tank plates	2.10
Beams, etc.	2.10
Skelp, grooved steel	1.90
Steel strip	2.15
Sheets, galv., No. 24	3.50
Wire nails	2.45
Plain wire	2.60
Barbed wire, galv.	3.20
Tinplates, 100-lb. box	$5.35

COKE (at ovens)

Welsh foundry	38/6 to 42/6
" furnace	27/- to 29/-
Durham foundry	34/6
" furnace	27/6
Scottish foundry	35/-
" furnace	30/-

TINPLATES

f.o.b. British Channel ports.

I.C. cokes	20×14 per box		20/3 to 21/6
"	28×20 "		40/6 to 43/-
"	20×10 "		29/-
"	18 3/4×14 "		21/-
C.W.	20×14 "		19/- to 20/3
"	28×20 "		38/- to 40/6
"	20×10 "		27/-
"	18 3/4×14 "		19/9

SWEDISH CHARCOAL IRON & STEEL

	£	s.	d.		£	s.	d.
Pig-iron	£9	0	0	to £10	0	0	
Bars-hammered, basis	£19	0	0	to £20	0	0	
Bars and nail-rods, rolled, basis	£19	0	0	to £20	0	0	
Blooms	£17	10	0	to £18	0	0	
Keg steel	£27	0	0	to £30	0	0	
Faggot steel	£19	0	0	to £24	0	0	
Bars and rods dead soft st'l	£12	0	0	to £15	0	0	

All per English ton, f.o.b. Gothenburg
[Subject to an exchange basis of Kr. 19.39 to £1.]

DAILY FLUCTUATIONS

Standard Copper (cash)

	£ s. d.	
Sept. 15 ..	42 11 3	inc. 22/6
„ 16 ..	42 13 9	„ 2/6
„ 19 ..	43 7 6	„ 13/9
„ 20 ..	42 16 3	dec. 11/3
„ 21 ..	42 10 0	„ 6/3

Electrolytic Copper

	£ s. d.	
Sept. 15 ..	47 15 0	inc. 15/-
„ 16 ..	47 15 0	No change
„ 19 ..	48 5 0	inc. 10/-
„ 20 ..	48 0 0	dec. 5/-
„ 21 ..	48 0 0	No change

Standard Tin (cash)

	£ s. d.	
Sept. 15 ..	195 5 0	inc. 55/-
„ 16 ..	194 10 0	dec. 15/-
„ 19 ..	196 5 0	inc. 35/-
„ 20 ..	195 15 0	dec. 10/-
„ 21 ..	195 5 0	„ 10/-

Tin (English ingots)

	£ s. d.	
Sept. 15 ..	195 5 0	inc. 55/-
„ 16 ..	194 15 0	dec. 10/-
„ 19 ..	196 10 0	inc. 35/-
„ 20 ..	195 15 0	dec. 15/-
„ 21 ..	195 5 0	„ 10/-

Spelter (ordinary)

	£ s. d.	
Sept. 15 ..	14 5 0	inc. 2/6
„ 16 ..	14 16 3	„ 11/3
„ 19 ..	14 15 0	dec. 1/3
„ 20 ..	14 5 0	„ 10/-
„ 21 ..	14 6 3	inc. 1/3

Spelter (Electro, 99.9 per cent.)

	£ s. d.	
Sept. 15 ..	18 5 0	inc. 2/6
„ 16 ..	18 16 3	„ 11/3
„ 19 ..	18 16 3	No change
„ 20 ..	18 6 3	dec. 10/-
„ 21 ..	18 7 6	inc. 1/3

Lead (soft foreign, prompt)

	£ s. d.	
Sept. 15 ..	15 15 0	inc. 5/-
„ 16 ..	15 16 3	„ 1/3
„ 19 ..	16 2 6	„ 6/3
„ 20 ..	16 0 0	dec. 2/6
„ 21 ..	15 17 6	„ 2/6

Lead (English)

	£ s. d.	
Sept. 15 ..	17 15 0	inc. 5/-
„ 16 ..	18 0 0	„ 5/-
„ 19 ..	18 5 0	„ 5/-
„ 20 ..	18 0 0	dec. 5/-
„ 21 ..	18 0 0	No change

Imports and Exports of Pig-iron, Castings, etc., in August and the Eight Months 1938, compared with August and the Eight Months 1937

	August.		Eight months.		August.		Eight months.	
	1937.	1938.	1937.	1938.	1937.	1938.	1937.	1938.
	Tons.	Tons.	Tons.	Tons.	£	£	£	£
Imports.								
Pig-iron—from British India	25,726	6,771	130,788	148,280	108,798	31,459	496,059	731,129
„ „ Other British Countries	17,350	—	36,456	—	113,985	—	203,438	—
„ „ Foreign Countries	50,948	2,291	191,615	211,570	315,745	24,951	1,126,833	1,219,375
Total	94,024	9,062	358,859	359,850	538,528	56,410	1,826,330	1,950,504
Castings and forgings	269	281	1,819	2,875	10,103	13,380	57,955	103,430
Cast pipes and fittings	113	60	897	572	3,098	4,056	23,259	21,274
Stoves, grates, etc.	259	174	660	579	13,443	9,322	62,352	50,190
Baths	577	716	6,390	4,952	14,227	17,336	156,008	125,949
Hollow-ware, all kinds	398	309	2,590	2,355	24,200	18,839	152,941	149,015
Exports.								
Pig-iron, forge and foundry	7,830	2,193	64,453	27,319	47,007	14,312	339,261	189,715
„ acid	5,812	1,915	41,817	17,617	33,527	11,681	224,932	124,615
„ basic	151	—	668	22	1,519	—	4,591	95
Total	13,793	4,108	106,938	44,958	82,053	25,993	568,784	314,425
Castings and forgings	154	94	2,185	1,536	6,471	4,879	83,639	57,170
Cast pipes and fittings, up to 6 in. diameter	4,485	4,441	39,919	31,855	53,957	54,605	443,449	404,523
„ „ „ over 6 in. „	4,545	3,074	32,874	30,129	36,361	30,626	258,860	314,404
Stoves, grates, etc.	845	726	7,619	5,689	43,696	39,437	407,186	327,474
Sanitary cisterns	260	178	2,412	1,710	8,855	6,576	80,333	65,077
Bedsteads, including tubes therefor	408	146	4,006	1,456	18,342	7,006	154,201	67,834
Hollow-ware, all kinds	1,046	627	9,249	5,104	62,420	39,192	480,689	318,436

WILLIAM JACKS & COMPANY,
WINCHESTER HOUSE, OLD BROAD ST., LONDON, E.C.2.

CLARENCE CHAMBERS, 39, CORPORATION STREET, BIRMINGHAM.
13, RUMFORD STREET, LIVERPOOL.

PIG IRON

REGISTERED TRADE MARK

All grades FOUNDRY, HEMATITE, BASIC, SPECIALS, &c.

NON-FERROUS METALS

COPPER, TIN, LEAD, SPELTER, ANTIMONY, CHROME ORE.

WILLIAM JACKS & COMPANY,
CENTRAL CHAMBERS, 93, HOPE ST., GLASGOW, C.2.
ZETLAND ROAD, MIDDLESBROUGH.

Notice

Small Advertisements in this section of the Journal are accepted at the prepaid rate of 6d. per line, first line in capitals counting two, average 6 words per line. Minimum charge for one insertion 3/-

(A remittance should accompany instructions.)

SITUATIONS VACANT AND WANTED

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